MINISTRY OF THE ENVIRONMENT
LABORATORY SERVICES BRANCH

Ontario

A GUIDE TO AIR FILTER (HI-VOL AND PM10) SAMPLING AND SUBMISSION

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Issue 1: November, 2000

Acknowledgments

The authors would like to thank the following people for their review of this manual and their valuable comments:

Gerald Diamond
Frank Dobroff
Leighton Horner
Don Racette
Fred Seymour

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A GUIDE TO AIR FILTER (HI-VOL AND PM10) SAMPLING AND SUBMISSION

1 INTRODUCTION

Suspended particulate matter in the atmosphere results both from natural sources and anthropogenic activity. Natural sources include wind blown dust, volcanic ash, pollen, smoke and fly ash from forest fires. Man's activities have greatly increased average levels of suspended particulate, with the highest concentrations found in industrialized downtown areas, as well as near expressways and, to a lesser extent, solid waste incinerators. Residential locations report relatively low levels of air particulate. Rural areas also follow this pattern except during tilling when conditions are dry and windy.

Suspended particulates in the atmosphere can cause: a reduction in visibility; alterations in sky illumination due to changes in the light scattering pattern; a decrease in the amount of solar radiation reaching the earth's surface; an increase in damage to vegetation and property; and an increase in physiological reactions including allergies and irritation to the respiratory tract. Health agencies have determined that particles of less than 5μm in diameter can enter the respiratory tract and cause health problems.

The current accepted Ontario ambient air quality criterion (AAQC) for Total Suspended Particulate (TSP) on high volume (Hi-vol) filters is 120 $\mu g/m^3$ for a 24-hour period and an annual geometric mean of 60 $\mu g/m^3$. The current Ontario interim AAQC for inhaleable fine particles less than 10 μm (PM10) is 50 $\mu g/m^3$ for 24-hours.

1.1 TSP

- The method commonly used for determining the quantity of total suspended particulate matter in the atmosphere uses a Hi-vol sampler that draws air through a glass fiber filter. Samples are under a shelter which excludes precipitation and particulate larger than about 100 μm.

- The glass fiber filters 20.3 X 25.4 cm (8" X 10") in size have a collection effeciency of at least 99% for particles of 0.3 μm in diameter. Particles with diameters exceeding 100 μm remain on the filter surface whereas particles with diameters down to 0.1 μm are collected on the glass fibers in the filters.

- Some inorganic tests are incompatible with the glass-fibre matrix. These include: Al, Ba, B, Ca, Na, K, Si, and F.

1.2 PM10

- Inhaleable particulate having an aerodynamic diameter of less than 10 μm is collected by placing a size selective inlet (a round, engineered top) on a high-volume sampler, and employing quartz-fibre filters 20.3 X 25.4 cm (8" X 10") in size.

- Some inorganic tests are incompatible with the quartz-fibre matrix. These include: Al, Ba, B, Na, Si and F.

2 SETTING UP A NEW SAMPLING STATION

A new routine sampling station must fit in with the allotted laboratory workload for that region. This is the responsibility of the Technical Support Manager. Changes should be requested through the Workload Coordinator for Operations Division.

A complete set of information must be submitted to the Laboratory Services Branch (LSB) Inorganic Air Unit, so that a new submission form can be generated. This information includes:

- Client contact, client code, ministry, branch, office address, city/town, postal code, telephone and fax numbers,
- Sampler's name and telephone number,
- Program code, priority, station ID, sample location, municipality, matrix, sampling start date and sampling schedule (e.g. 1, 3, or 6-day cycle) and Laboratory Information Management System (LIMS) product(s).

3 ORDERING BLANK FILTERS

Hi-vol air filters are ordered from the contract laboratory:

Seprotech Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1
Attention: Dave Lambert

Telephone (613) 523-1641
Fax (613) 731-0851
E-mail: dlambert@Seprotech.com

PM-10 filters are ordered from LSB:

Ministry of the Environment
Laboratory Services Branch
Physical Chemistry & Litigation Services Section
Inorganic Air Unit
125 Resources Road
Etobicoke, ON M9P 3V6
Attention: Kirsten Burling

Telephone (416) 235-5849
Fax (416) 235-6113
E-mail: burlinki@ene.gov.on.ca

Alternate:
Customer Services Help Desk

Telephone (416) 235-6030
Fax (416) 235-6141

Blank filters should be ordered three weeks ahead of the required time. The order should include :

- the name and address of the person to whom the filters will be sent.
- the type of filter - PM10 or Hi-vol.
- the station number.
- the last filter number received, unless it is a new station.
- the number of filters required (if other than the usual 25).
- the date by which the filters should arrive at the requesting office.

Blank filters are stamped with an eight-digit identification number on the top left and the bottom right corner of the filter. The numbers are placed on the screen-pressed surface which is the one with the least fibre surface area.

When the exposed filter is returned to the laboratory, its eight-digit identification number is used to match the filter to its tare weight. The sample is then conditioned and weighed. The two weights (unexposed and exposed) are then used to calculate the particulate loading.

The filter batch (lot number) is stamped in the bottom left corner of the screen-pressed surface of each filter. In this way, unused filters which are returned to the laboratory are identified as to their batch and thus filters with the same station-filter number may be distinguished from one another (these numbers repeat after every 999 filters).

4 RETURNING UNUSED BLANK FILTERS

Unused filters from terminated stations, etc., should be returned to the Inorganic Air Unit, Laboratory Services Branch. They should be returned in the original box in which they were sent out as it has the station, filter and batch numbers on it. If a substitute box is used, then a note should be included with the station number, the batch number, the first and last filter numbers being returned and the reason for the return (e.g. station terminated or wrong station stamped on filter. Do not mix batches or stations together. These filters may then be restamped and sent out again.

5 SAMPLER

Samples are collected by means of a high-flow-rate sampler capable of drawing air at a rate of 1.3 m^3/minute. The sampler is calibrated at 1.13 m^3/minute (40 cfm) and usually runs for a 24-hour period using a flow controller.

5.1 MAINTENANCE OF HIGH-VOLUME SAMPLERS

Certain maintenance procedures help ensure problem-free samples:

a) Motor brushes should be replaced periodically. This is done after approximately 400 to 500 hours of operation at 115 volts. A "Step-down" transformer can be used to increase brush life.
b) Motor gaskets are cleaned as needed and replaced when worn.
c) The flow-measuring device and tubing are inspected visually each time a filter is changed and are cleaned or replaced as needed.
d) The faceplate gasket is replaced when worn or cracked through. (Exposed filters may show signs of particulate seepage under the gasket before the gasket appears to be worn).
e) The inside of the sampler (shelter and roof) should be cleaned:
   - The Hi-vol sampler, annually or as needed with a coarse wire brush.
   - The PM10 sampler, after every 4th sampling day or more frequently, as required.
f) The sampler must be visually clean. With each use, it is inspected for bird and wasp nests, spider webs and insects and droppings. If found, they must be removed.
g) The filter-holder, especially the gasket and horn, is cleaned of dirt each time the filter is changed.
h) The filter-holder housing is inspected for leaks each time a filter is changed.
i) The shelter is inspected for leaks whenever a new head is used.

6 EXPOSING FILTERS

If a new, unused filter is damaged, such that it may compromise the collection of suspended particulate, the filter must not be used. Small imperfections along the margin of the filter will not affect particulate collection as long as the filter is centered in the filter holder.

- Care must be taken not to contaminate the filter. Hands and filter holder (particularly the faceplate gasket) should be clean.

- The filter is to be installed with the side having the greater fibre surface area facing upward. The surface of this side looks less compacted and more irregular. The filter identification numbers should be facing downward. They should be on the side which has the flattened, screen-pressed look to it. The proper side should be exposed regardless of which side has the numbers.

- Filters should be exposed in numerical order.

- The filter is centered in the holder so that the unexposed margin is even all the way around. If not centered, when the filter is folded, some of the particulate from one side will be transferred to the margin of the other side.

The faceplate gasket should form a seal around the filter and be seated tightly enough that particulate cannot seep underneath. The gasket should be free of cracks through which particulate may escape.

7 EXPOSED FILTERS

During the time that a filter sits in the sampler, circumstances may occur which could cause either a gain or a loss in the mass of the sample. Since the suspended particulate tests concern sample mass, what happens to the filter could be critical to the integrity of the result.

Filters must be handled carefully to avoid tearing, contamination or loss of particulate. Before a filter is removed from the sampler and, as it is being removed from the sampler, the filter is inspected for tears, scrapes, perforations and extraneous material. The latter should be removed if this can be done without disturbing the integrity of the filter and the particulate thereon.

Complete sample invalidation should be done by field staff before a sample is submitted. Laboratory staff cannot invalidate a filter sample without first consulting the region. A sample may however, be invalidated for a particular test by either field or laboratory staff. There are 3 ways in which a filter may be deleteriously affected: by a **loss** of mass, a **gain** of mass, or a **loss and gain** of mass. The severity of these conditions determine whether or not a filter is invalidated.

See Appendix A, for various examples of the above conditions.

8 SAMPLE AND SAMPLE ENVELOPE

The sample is carefully removed from the cassette or filter holder, folded in half across the middle of the longer 10 inch (25.4 cm.) side so that the particulate-covered surface is folded against itself.

PM10 filters are more delicate than Hi-vol filters. The filter is folded by placing it between the lines on the smooth cardstock folder, provided by the lab. It is held in place as the folder is folded. Pressure exerted by the fingers along the fold of the folder will press a fold into the filter.

Tears or scrapes occurring as the filter is being removed from the sampler as well as those having occurred during sampling, should be noted in the comments area on the sample envelope. Torn off pieces should be placed inside the folded filter, near the outer edge of the shorter ends.

The folded filter should be placed into the sample envelope with the fold on the left and the open side to the right. See Appendix B, Figure 1. (Sample envelopes are stored at the laboratory, with the left side down. In this way, any loose, dislodged particulate will be caught in the fold of the filter.) The PM10 filter is left in the folder and both are placed with the fold on the left into the sample envelope for return to the laboratory.

The following information is **mandatory** for LSB and is entered onto each sample envelope. See Appendix B:

STATION - The station number is the sampling location. Normally, this is the first 5 digits of the 8-digit number stamped on the top left and bottom right corner of the filter (if the filter is exposed at a station other than the one for which it was stamped, the entire 8-digit number **must be** put on the FILTER No. line. Print the number of the station at which the filter was exposed, on the STATION number line)

DATE - The sampling date is the day (or the first day of a series of days) that the filter was exposed.

The format is DD-MMM-YYYY (e.g. 13-OCT-1999).

FILTER No. - This is the last 3 digits of the 8-digit number that is stamped on top left and bottom right corner of the filter, (if the filter is exposed at a station other than the one for which it was stamped, the entire 8-digit number should be put in the FILTER No. space. Print the number of the station at which the filter was exposed, on the STATION number line). See Appendix B, Figure 2.

TYPE - For Hi-vol enter HG (Hi-vol Glass); for PM10 enter QU (Quartz).

BATCH No. - This is the number on the bottom left of the filter.

TOTAL VOLUME - This is the actual calculated air volume. (See next heading, COMMENTS.)

COMMENTS - If a sample is invalid, the word INVALID is printed on this line and the air volume is not reported.

Other information may also be entered onto the envelope. Comments regarding unusual sampling conditions should be noted. This information may be important during data evaluation.

Avoid writing comments on the bottom right corner of the sample envelope as laboratory sample numbers will be applied to this area.

9 INVALIDATION OF SAMPLES

Comments relating to validity of the sample should be entered for the benefit of both laboratory staff and Regional Analyst.

Questionable samples may be returned to the Regional Analyst.

9.1 SAMPLE INVALID FOR ALL ANALYSES

Samples are invalidated under the following circumstances:

(1) If site access or other circumstances prevent the sample from being taken.

(2) If vandalism is suspected.

(3) If field equipment such as the sampler motor or the flow controller fail to function properly.

(4) If a perforation or tear of any size occurs within the particulate collection area during sampling.

(5) If a leak in the gasket seal occurs during sampling and evidence of the leak extends to the edge of the filter.

(6) If bird droppings contaminate more than 5% (4 square inches) of the exposed filter.

(7) If two filters are exposed simultaneously in the same sampler.

(8) If a filter is exposed on an unscheduled sample day.

If a sample which has not been invalidated is suspected of being invalid, the sample should be sent for final validity determination to the Regional Analyst for the region which generated the sample.

If a sample is invalid:

- On the sample envelope, "INVALID" is printed in the comments area and the air volume is left blank. See Appendix B, Figure 1.

- On the submission form, the air volume box should contain the word "INVALID". The product for any invalid filter, is TSPINV3288. This product is entered on the submission sheet instead of the normal product(s). See Appendix C, Figure 1 and Appendix D, Table D-3.

9.2 SAMPLE INVALID FOR PARTICULATE ANALYSIS ONLY
(TSP2009 or TSP3288 or IP3288)

Samples may be invalid for the analysis of total suspended or inhaleable particulate and still be valid for the analysis of other parameters.

- There are two product codes in LIMS for Hi-vol samples: TSP2009 for the samples going to the private laboratory and TSP3288 for the samples going to the MOE LSB analyst (special cases).

- There is one PM10 LIMS code: IP3288 sends the quartz PM-10 filters to the MOE LSB analyst.

If a sample is invalidated for the particulate loading only, then, in the product column of the submission form, enter either **-TSP2009** or, **-TSP3288** or **-IP3288** (depending on which matrix/analysis and where the sample is going for analysis) along with the normal product, (e.g. HVT -TSP2009 or QUARTZ -IP3288). See Appendix C, Figure 4. This will notify data entry personnel to delete the particulate test from the parent product. The other tests will be entered as usual. The following conditions may invalidate the sample for particulate loading only:

(1) If there has been a significant loss of particulate material due to a tear or a scrape which occurred **after** sampling. For a Hi-vol sample, this would be approximately 0.045 grams of material. For a PM10 sample this would be about 0.022 grams of lost particulate.

(2) If a piece of filter tore off and was lost after the blank filter was shipped from the laboratory and the missing piece is about equal to 1 in^2 (2.5 cm^2) for Hi-vol or 0.5 in^2 (1.25 cm^2) for PM10.

(3) If bird droppings contaminate less than 5% (4 square inches) of the filter, the filter **may** still be valid for other tests. **It is mandatory that the contaminated part of the filter not to be used is clearly indicated on the envelope.**

(4) If non-target material such as insects or plant matter adhered to the filter, then the material should be removed prior to submitting the sample to the laboratory. This is most easily done with pointed forceps. If this material was large and is estimated to have interfered with the collection of particulate directly onto the filter, then the sample should be invalidated for particulate loading.

The Product code TSPINV3288 is assigned to an invalid sample for tracking purposes.

10 SUBMISSION FORM

See Appendix C for examples of submission forms.

Submission forms are generated by LSB. They are bar-coded to facilitate data entry. The preprinted information must be verified as being correct. If there are errors or changes, the incorrect information is to be corrected on the submission sheet and e-mailed to the Laboratory Services Branch contact.

10.1 SUBMISSION FORM HEADER

Submission Number - This is normally left blank by the field staff. Laboratory staff will place a bar-coded label on this box.

Prelog Number - This is currently unused. Eventually, each sample will be assigned a LIMS prelog sample number. This number will become the submission number when the filters are submitted for analyses. The prelog number will begin with the letter P and will be changed to a C (for Central Laboratory) when the sample is returned and received back into LIMS at the lab. The P designated number is to be used as a submission number by clients.

Client Contact - This is the person to whom the final data will be sent (usually the data analyst).

Client ID - This is the 5-digit LIMS code for the client contact.

Program Code - This is the 9-digit code determined by the Regional Tech Support Manager. It is a string of 4 codes. All codes begin with 13011.

- 13 indicates the program - MOE Operations Division.
- 011 indicates the study - air (industrial, commercial, private or networks).
- the next two digits indicate the project, e.g. **41** - Southwestern Region, London District.
- last two digits indicate the activity:
  - 01 - AQ (Air Quality Index) & API (Air Pollution Index) stations
  - 02 - point source monitoring
  - 03 - ambient monitoring
  - 04 - studies
  - 05 - complaints & notifications

Priority - This is the assigned urgency of analysis. Priorities other than NN require a request from the appropriate Director to the LSB Director.

- NN ROUTINE
- EM EMERGENCY - HEALTH RISK (ASAP)
- PR PRIORITY - RUSH (7 DAYS)
- RE REGULATION (30 DAY TURNAROUND TIME)
- CC POTENTIAL LITIGATION (COURT CASE)

Page - The first page of the submission is labeled Page 1. For the 3 day cycle the pages are labeled 1 of 2 and 2 of 2.

Sample Location / Municipality - This is the station name (which includes a street name or intersection), as well as the municipal jurisdiction (City/Town), (e.g. Gertrude & Depew /Hamilton).

Date Submitted - This is the date that the samples are sent or taken to the laboratory for analysis.

Ministry / Branch / Office - This is the address of the client contact to whom the final reports will be sent. Usually, this is the Ministry of the Environment / the region or district / the street address (e.g. Ministry of the Environment, Southwestern Region, 659 Exeter Road South, 2nd floor).

Telephone Number - This is the telephone number of the client contact.

Fax Number - This is the fax number for the client contact.

City / Town - This is for the mailing address of the client contact.

Postal Code - This is for the mailing address of the client contact.

Sampled By - **Name** - this is the name of the sampler(s) responsible for producing the samples being submitted.
- **Telephone Number** - This is the telephone number of the sampler.

Station ID - this is the unique, 5-digit, station, location, identification number.

Matrix -Sample matrix is one of the following: AG - Air-filter, Glass-fibre; AQ - Air-filter, Quartz-fibre; AO - Air, Other filters and puff. (This guide deals with only AG and AQ).

Sample Reception / Data Entry - This area is to be left blank for laboratory staff.

10.2 SUBMISSION FORM BODY

Lab Sample Number - These two columns are left blank for laboratory staff.

Sample Number - This is the identification number assigned to a sample. Laboratory staff will place a bar-coded label in this box and a similar label on the sample envelope just above the bottom fold on the right side.

MOE*LIMS - This number indicates the year, the sample matrix, the week the sample was entered into LIMS and the number of samples of that matrix received to date for the week.

Sample Date - This is the exposure date for the filter. It is the first day if there was more than one day of exposure. The format is DD-MMM-YYYY (e.g. 03-OCT-1999).

Filter Number - This is the running number from 001 to 999. Following number 999 the filters begin again with 001. (If a filter was exposed at a station other than the one for which it had been stamped, then the entire 8-digit number **must be** entered as the filter number).

Batch Number - This is the number which is stamped or written on the bottom left corner of the filter. These numbers vary in length and in characters which may be a combination of numbers and letters. Different batch numbers may be very similar, differing by only a single digit. The correct batch is required for proper laboratory analysis.

Air Volume - This is the calculated air volume.

Product - This box is for the requested test or test group. Air filters usually use Parent Products (Appendix D) which are group codes; each Parent Product contains one or more Products. A product(s) may be requested, in addition to, or deleted from, a parent product. PM10 samples have only one parent product which is the word QUARTZ. The Parent Product QUARTZ contains the Products for inhaleable particulate, one anion and nine metals. The Hi-vol parent product, HVD includes the products for TSP, three anions and eight metals.

TSPINV3288 is a product which is used instead of a parent product for all invalid samples, whether Hi-vol or PM10. This code allows the sample to be recorded in LIMS without any analyses being performed.

Information placed in either of the following two areas will be typed into Laboratory Information Management System (LIMS) and should be legible. Comments typed elsewhere on the submission form will not be typed into LIMS. Comments relating to validity or to any unusual features of the sample should be entered for the benefit of both laboratory staff and Regional Analyst.

Field Staff Remarks - This column is for short remarks. A remark which applies to consecutive samples may be placed in this column and dittoed down or arrowed down through those consecutive samples.

Additional Comments - This field, at the bottom of the page is for longer comments. Such comments may apply to one or more samples or to the entire submission.

Field Staff Remarks, Check Filter - Yes
A check mark should be placed on this line only if there is something wrong with the filter and the field technician does not know what to say about it in the way of remarks. A check mark on the line following the word "Yes", indicates that the particulate analyst should look at it before it is weighed. If a sample has been invalidated, there should be no need for it to be checked. If the field technician is not sure whether or not the sample should be invalidated, he or she should check the box to have the filter checked at the laboratory and include a note as to why. Please note: Laboratory staff do not invalidate samples without agreement from the regional office. They may, however, invalidate a filter for their particular test.

The air volume and product of the sample following an invalid filter must be properly coded.

When a station is terminated, it should be indicated in one of the comments sections.

11 NO SAMPLE

If there is no sample for a particular sampling date, it should be left on the submission form with the word INVALID in the air volume box and the code TSPINV3288 in the product box (see Section 9). If no filter was exposed, a line should be put through both the filter number and the batch number boxes.

12 SUBMITTING SAMPLES

The sample envelopes should be placed in chronological order. The submission sheet should be wrapped around them with the information visible (i.e. facing outward) and put into a corrugated box or padded envelope for shipping. Samples should be shipped flat or with the folded end of the filter in the down position, with the sample envelope facing left to prevent loss of particulates.

Samples are submitted to the laboratory on a monthly basis, within 30 days of the end of the month in which they were exposed.

If a Hi-vol station does not require TSP2009, then filters and submissions are submitted to LSB.

PM-10 filters and submission forms, and the original submission forms for Hi-vol filters are sent to:

Ministry of the Environment
Laboratory Services Branch
Physical Chemistry and Litigation Services Section
Inorganic Air Unit
125 Resources Road
Etobicoke, ON M9P 3V6
Attention: K. Burling

and copies of the Hi-vol submission forms are sent with the filters to:

Seprotech Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1
Attention: D. Lambert

13 LIMS REMARK CODES AND VALUE QUALIFIERS

Below are lists of some of the LIMS remark codes and value qualifier codes that may appear on a final report.

13.1 REMARK CODES ("Rmks" on final report):

EAC - equals or exceeds air guidelines
EV - estimated value - tare weight unavailable
PIE - possible improper exposure
PFC - possible filter contamination
PPL - possible particulate loss (Notes 1, 2)
RRV - reported result verified by repeat analysis
SVH - sample volume too high. Check hi-vol for leakage
TEXT - textual information provided - see end of report
TF - torn filter (Notes 1, 2)
UCR - unreliable: could not confirm by reanalysis
UCS - unreliable: contamination suspected
UMF - unreliable: multiple filters submitted
UNH - unreliable: sample not homogeneous
UTF - unreliable: torn filter

13.2 VALUE QUALIFIERS ("Qual" on final report):

> - actual result is greater than the reported value
< - actual result is less than the reported value
<T - a measurable trace amount: interpret with caution (Note 3)
<W - no measurable response (zero): less than reported value (Note 4)
NDAI - no data: additional information available
NDAR - no data: see attached report
NDAW - no data: analysis withdrawn
NDCR - no data: could not perform confirming re-analysis

NDCS - no data: contamination suspected
NDIF - no data: invalid filter (no air volume) (Notes 5, 6)
NDIL - no data: sample incorrectly labeled
NDIV - no data: invalid sample (Notes 5, 6)
NDLA - sample spoiled in laboratory accident
NDMT - no data: sample missing in transit
NDND - no data: not analysed (not done)
NDNF - no data: information not received from submittor
NDNN - no data: tests requested in error
NDNR - no data: sample not received at laboratory
NDPM - no data: piece missing
NDRE - no data: sample received empty
NDRL - no data: see attached report from LWA Section
NDRN - no data: result forthcoming from radiation lab
NDRR - no data: rerun has been initiated
NDSM - no data: sample missing
NDST - no data: see attached textual information
NDTF - no data: torn filter
NDTW - no data: tare weight > loaded weight
NDUA - no data: sample unsuitable for analysis

Notes:

1. TF denotes a small tear (< 4 inches) in the exposed area.
2. TF & PPL denotes a tear (≥ 4 inches) in the exposed area or a tear in the fold of a filter which contains loose particulate.
3. < 5 μg/m3 TSP, PM10.
4. < 1 μg/m3 TSP, PM10.
5. NDIF invalidates the sample for all tests. The product code TSPINV3288 is assigned for tracking purposes.
6. NDIV invalidates only the test(s) for which it is reported.

Note: Textual comments may be added in LIMS in addition to Remark Codes and Value Qualifiers.

Currently, only one LIMS code is printed beside the result on the final LIMS report. If more than one code is used, then the word TEXT will appear beside the result and the list of codes will be printed on the final page along with any textual comments.

If a result equals or exceeds the ambient air quality criterion, the code EAC will take precedence over TEXT.

GLOSSARY

ANION3004 - Analysed by ion chromatography.
- Hi-vol (AG matrix) reports nitrate as nitrogen, chloride and sulphate.
- PM10 (AQ matrix) reports only sulphate.

EDXRF - energy dispersive x-ray fluorescence.

HIVOL3070 - analysed by energy dispersive x-ray fluorescence (AG matrix), (includes cadmium, chromium, copper, iron, lead, manganese, nickel and vanadium).

IP3288 - Inhaleable particulate - quartz filters (analysis performed by the MOE laboratory).

LSB - Laboratory Services Branch.

Matrix - the medium from which a sample is taken, i.e. AG = glass-fibre filter, AQ = quartz-fibre filter.

Parameter - the actual analyte that is being tested (e.g. nickel) or a required piece of information about a particular sample (e.g. air volume).

Parent Product - a group of products with a common matrix that is used to speed up the logging in of multiple products for any given sample.

PB3233 - lead analysed by wavelength dispersive x-ray fluorescence (AG matrix).

Product - specifies the actual analytical test or tests to be conducted via a given method within a specified matrix.

RPL - Radiation Protection Laboratory, Ministry of Labour.

TSP2009 - Total Suspended Particulate - Hi-vol filters (analysis performed by a private laboratory).

TSP3288 - Total Suspended Particulate - Hi-vol filters (analysis performed by the MOE laboratory).

WDXRF - wavelength dispersive x-ray fluorescence.

XRF3277 - analysed by energy dispersive x-ray fluorescence (AQ matrix), (includes calcium, chromium, copper, iron, lead, manganese, nickel, vanadium and zinc).

ZN3070 - zinc analyzed by energy dispersive x-ray fluorescence (AG matrix).

CD3402 - cadmium analyzed by Inductively Coupled Plasma Mass Spectrometer (AQ Marix).

APPENDIX A

TYPES OF EXPOSED FILTERS

Plate 1. Appropriate Sample
This is a properly exposed filter. It is pale because it is from the control site at Dorset. The Total Suspended Particulate is only 5 $\mu g/m^3$.

Plate 1

Plate 2. Appropriate Sample
There is some seepage of particulate under the gasket but this affects neither TSP nor Inhaleable Particulate (IP). It may however, affect other analyses, so the word "seepage" is put in the comments area of the sample envelope to alert the analyst to be careful where he/she samples.

Plate 2

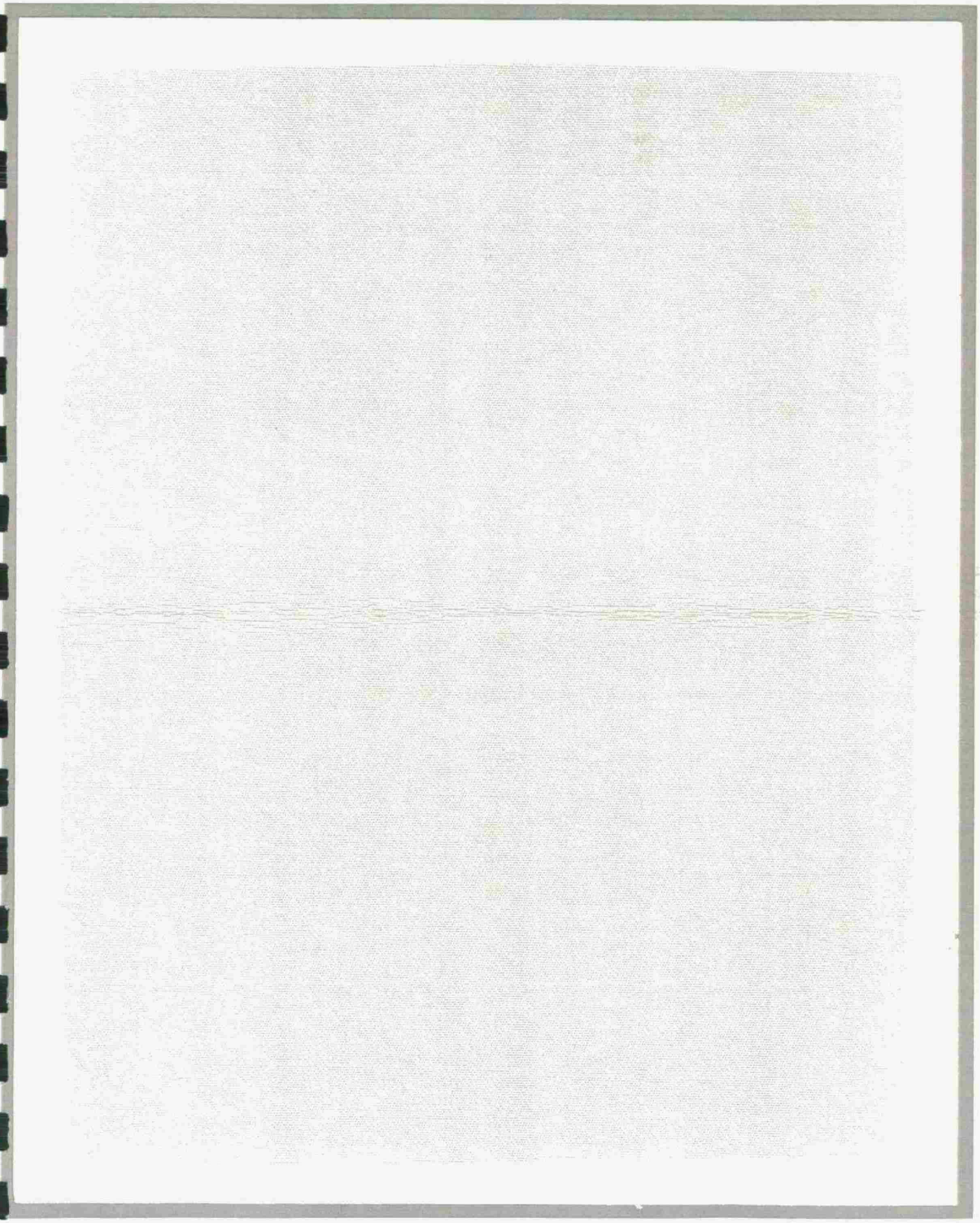


Plate 3. Appropriate Sample
Rain spots.
Rain markings appear pale on the particulate side of the filter.

Plate 3

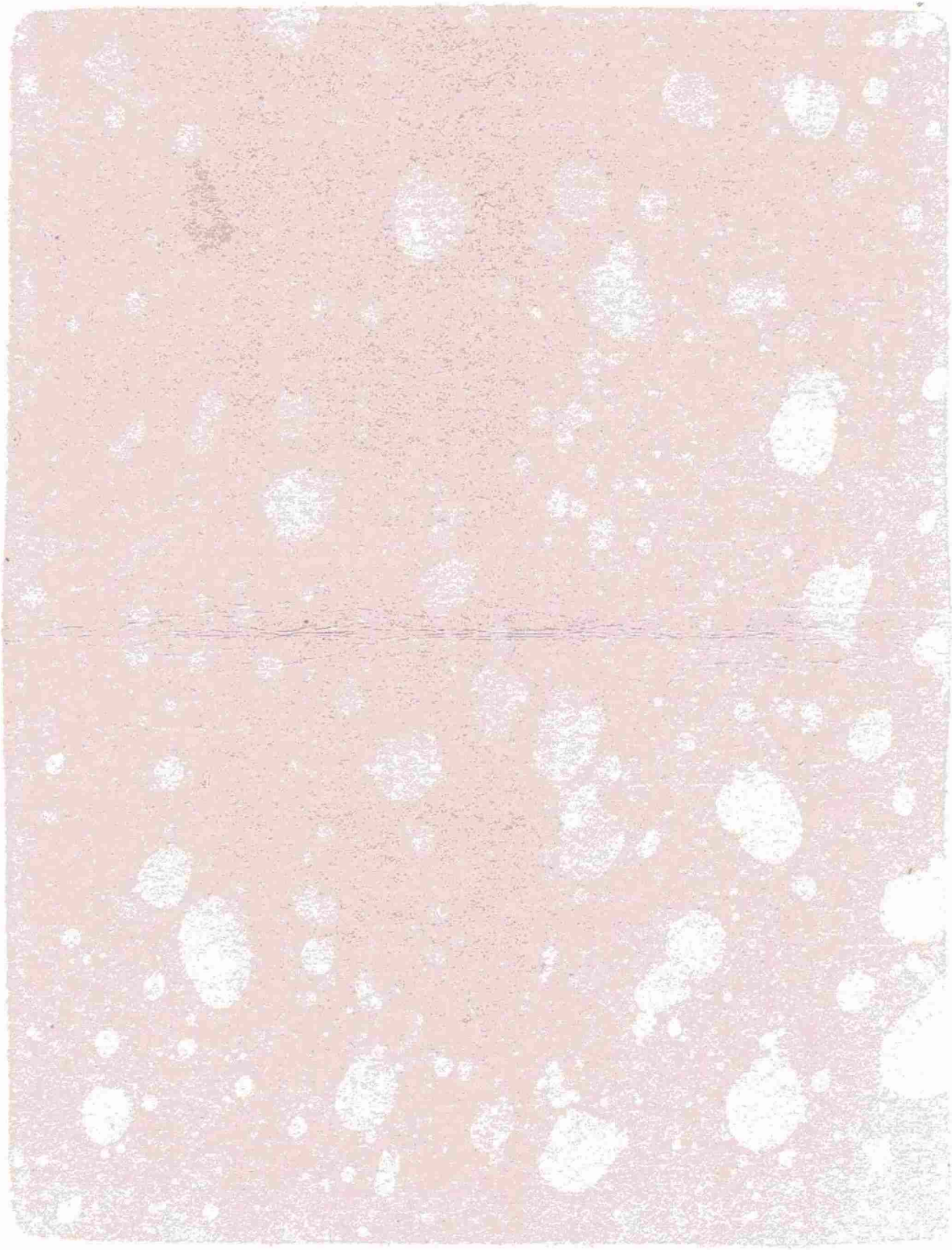


Plate 4. Appropriate Sample
The same rain spots as in Plate 3 as seen on the unexposed surface of the filter. Rain markings appear darker on this surface.

Plate 4

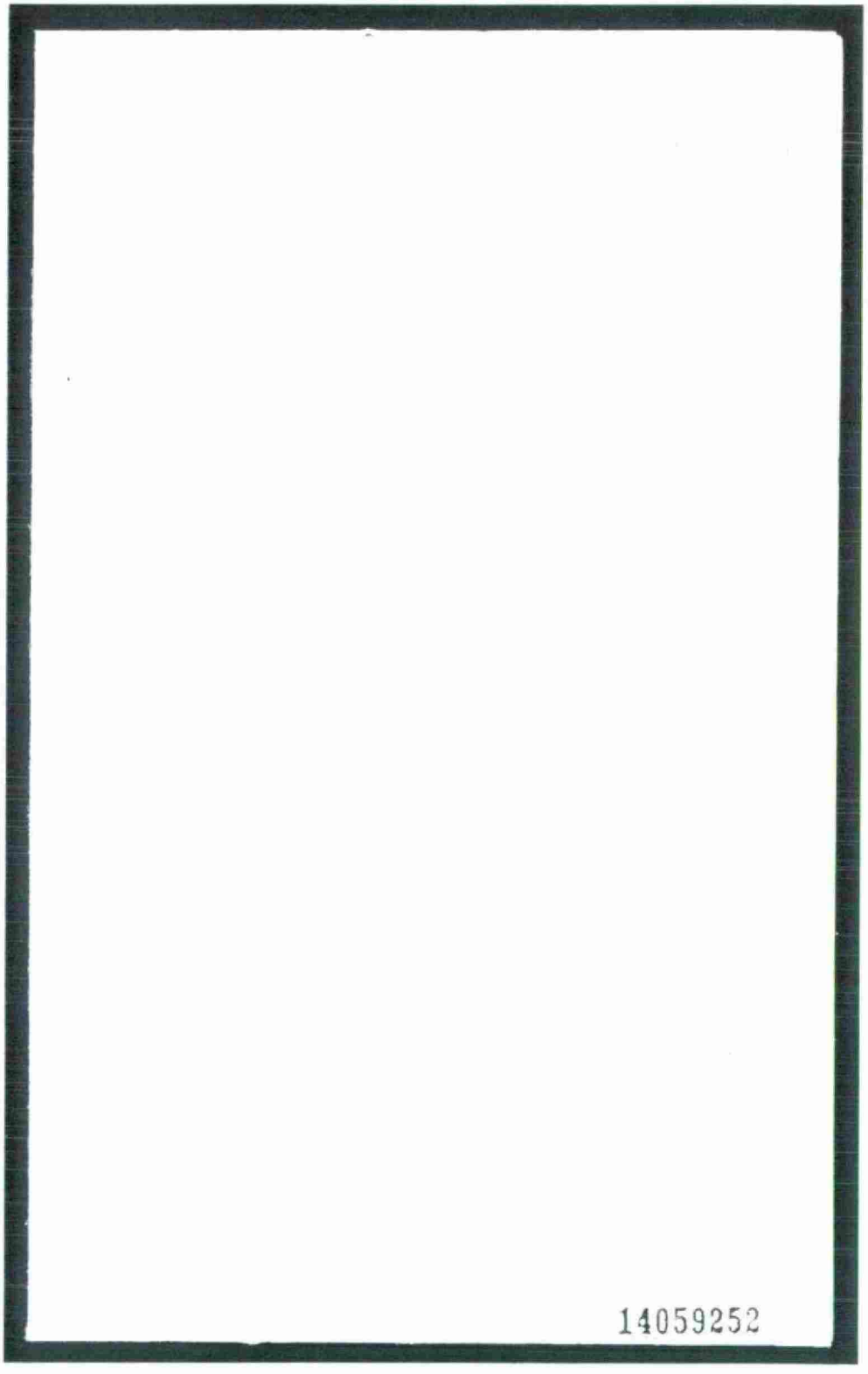
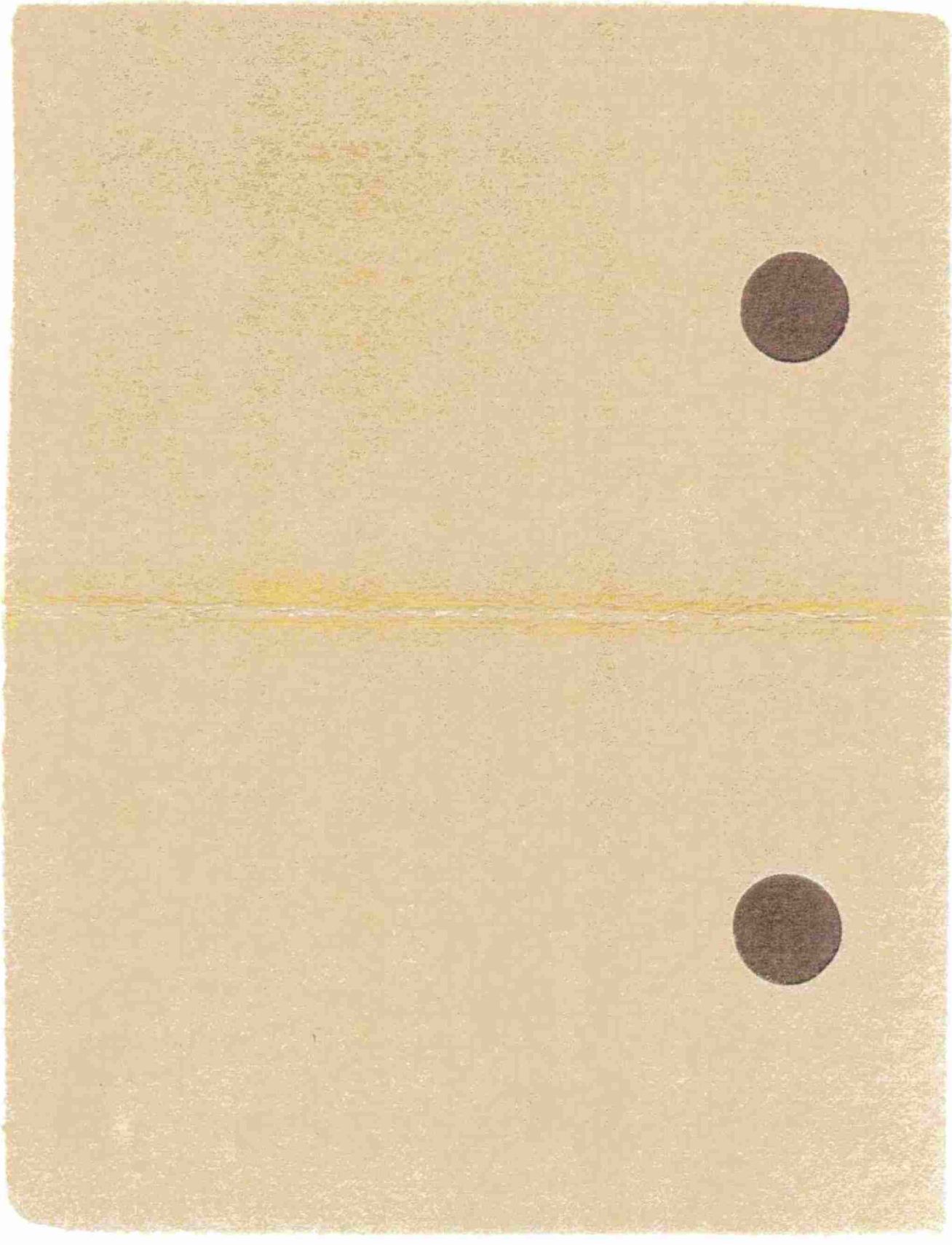


Plate 5. Appropriate Sample
Wood fibre may appear as a yellowish particulate. This could be sample contamination or it could be the actual substance being monitored.

Plate 5

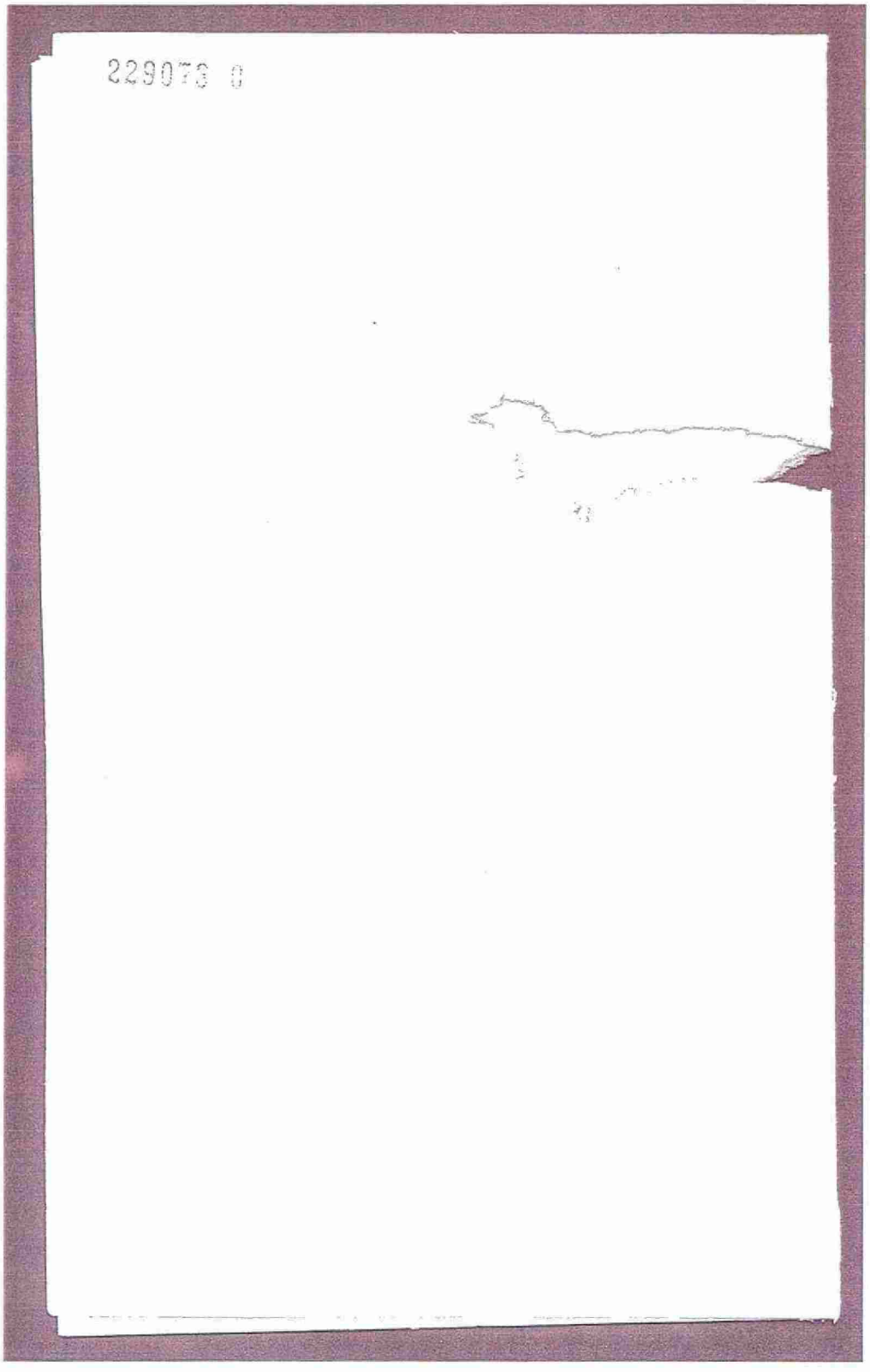


Plates. 6. Invalid Sample
Torn filter - pieces missing.
The filter tore during sampling. Note that the torn edge is darker than the rest of the exposed area of the filter.
Bird damage.
The loss of mass is estimated to be $\geq$ 1 in^2 (2.5 cm^2) of filter.
LIMS code NDIF: (No data; invalid filter)
(If the sample had not been invalidated in the field, they would have been invalidated in the laboratory with LIMS code NDIV (No data; invalid sample) for each test(s) or NDPM (No data; piece missing) for TSP.

Plate 6

Plates. 7. Invalid Sample
Torn filter - pieces missing.
The filter tore during sampling. Note that the torn edge is darker than the rest of the exposed area of the filter.
Bird damage.
The loss of mass is estimated to be ≥ 1 in^2 (2.5 cm^2) of filter.
LIMS code NDIF: (No data; invalid filter)
(If the sample had not been invalidated in the field, they would have been invalidated in the laboratory with LIMS code NDIV (No data; invalid sample) for each test(s) or NDPM (No data; piece missing) for TSP.

Plate 7



Plates. 8. Invalid Sample
The filters tore during sampling. Note that the torn edge is darker than the rest of the exposed area of the filter.
Bird damage.
The loss of mass is estimated to be $\geq$ 1 in^2 (2.5 cm^2) of filter.
LIMS code NDIF: (No data; invalid filter)
(If the sample had not been invalidated in the field, they would have been invalidated in the laboratory with LIMS code NDIV (No data; invalid sample) for each test(s) or NDPM (No data; piece missing) for TSP.

Plate 8

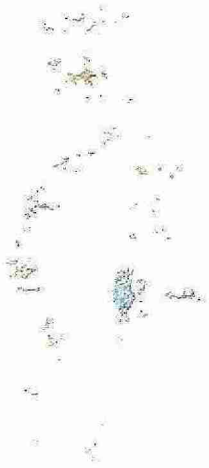
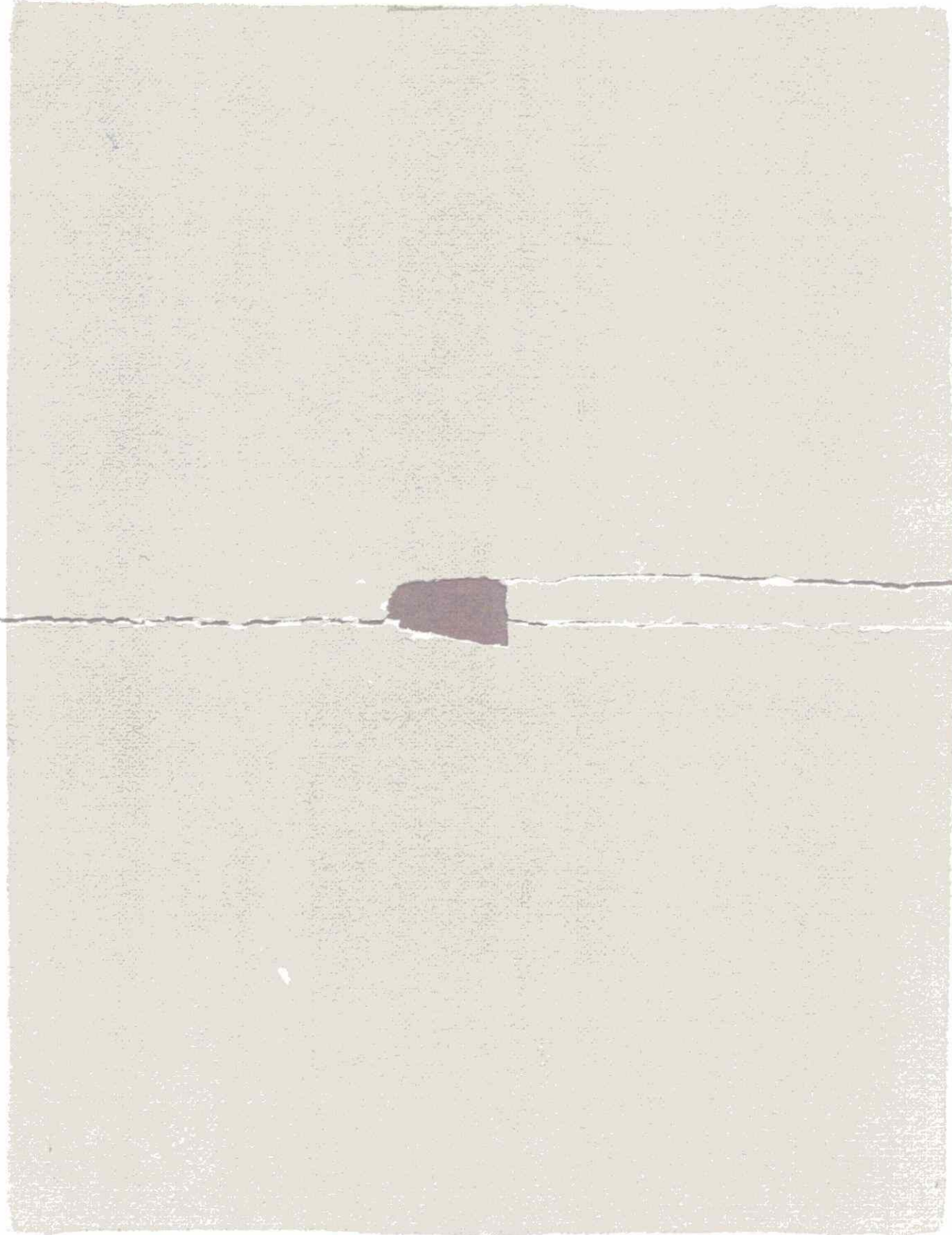


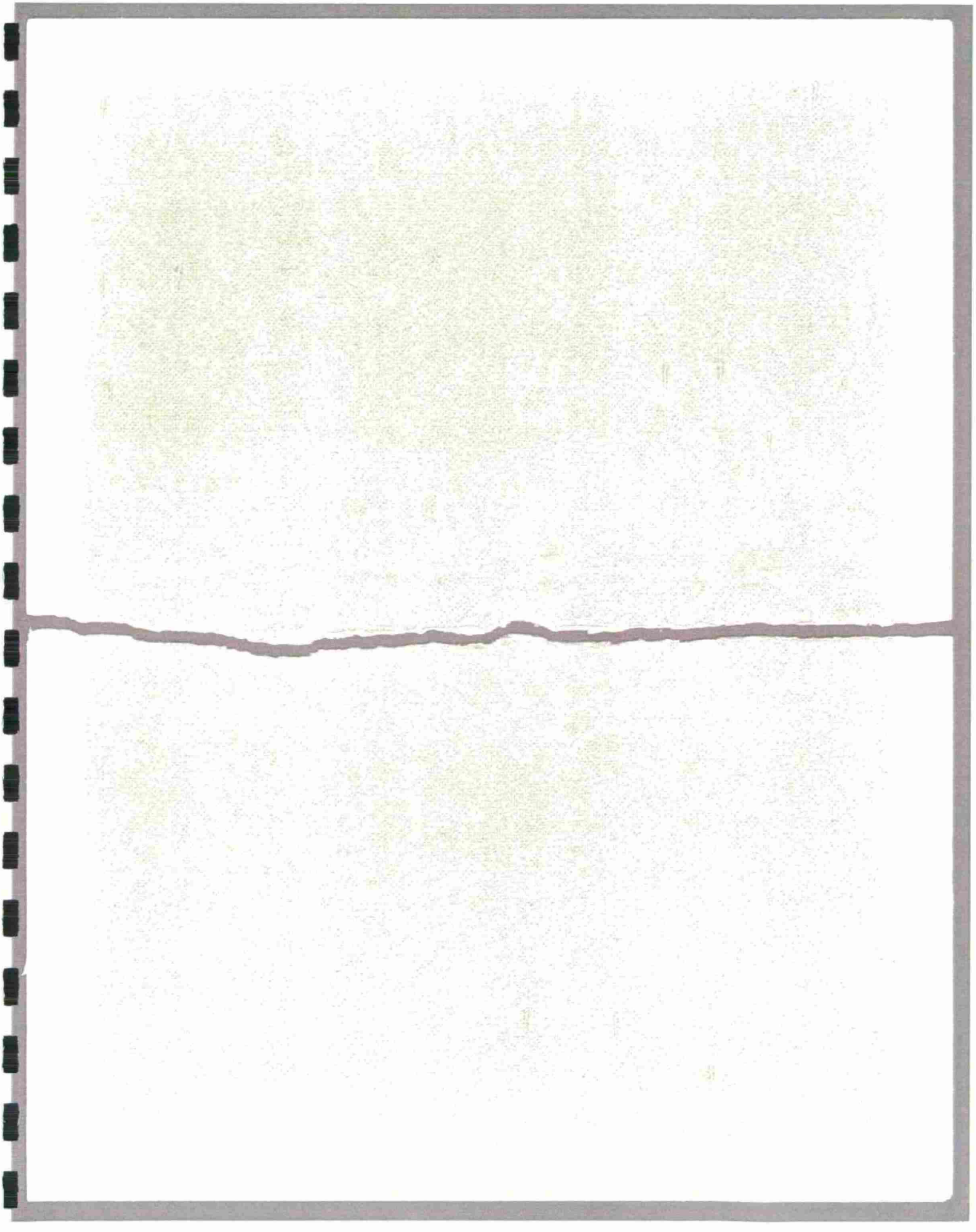
Plate 9. Valid Sample - Possible Loss of Mass
Torn filter - piece missing.
LIMS codes TF (torn filter), PPL (possible particulate loss).
Loss of mass estimated to be < 1 in^2 (2.5 cm^2) of filter.
The white area in the torn edge indicates that the tear occurred after sampling with resulting particulate loss.
Torn-off pieces should be placed inside the folded filter, near the outer edge (on the margin, if possible), put into the sample envelope and submitted to the lab.

Plate 9



Plates. 10. Valid Sample - Possible Loss of Mass
Torn filter.
LIMS codes TF (torn filter), PPL (possible particulate loss).

Plate 10



Plates 11. Valid Sample - Possible Loss of Mass
Torn filter.
LIMS codes TF (torn filter), PPL (possible particulate loss).

Plate 11

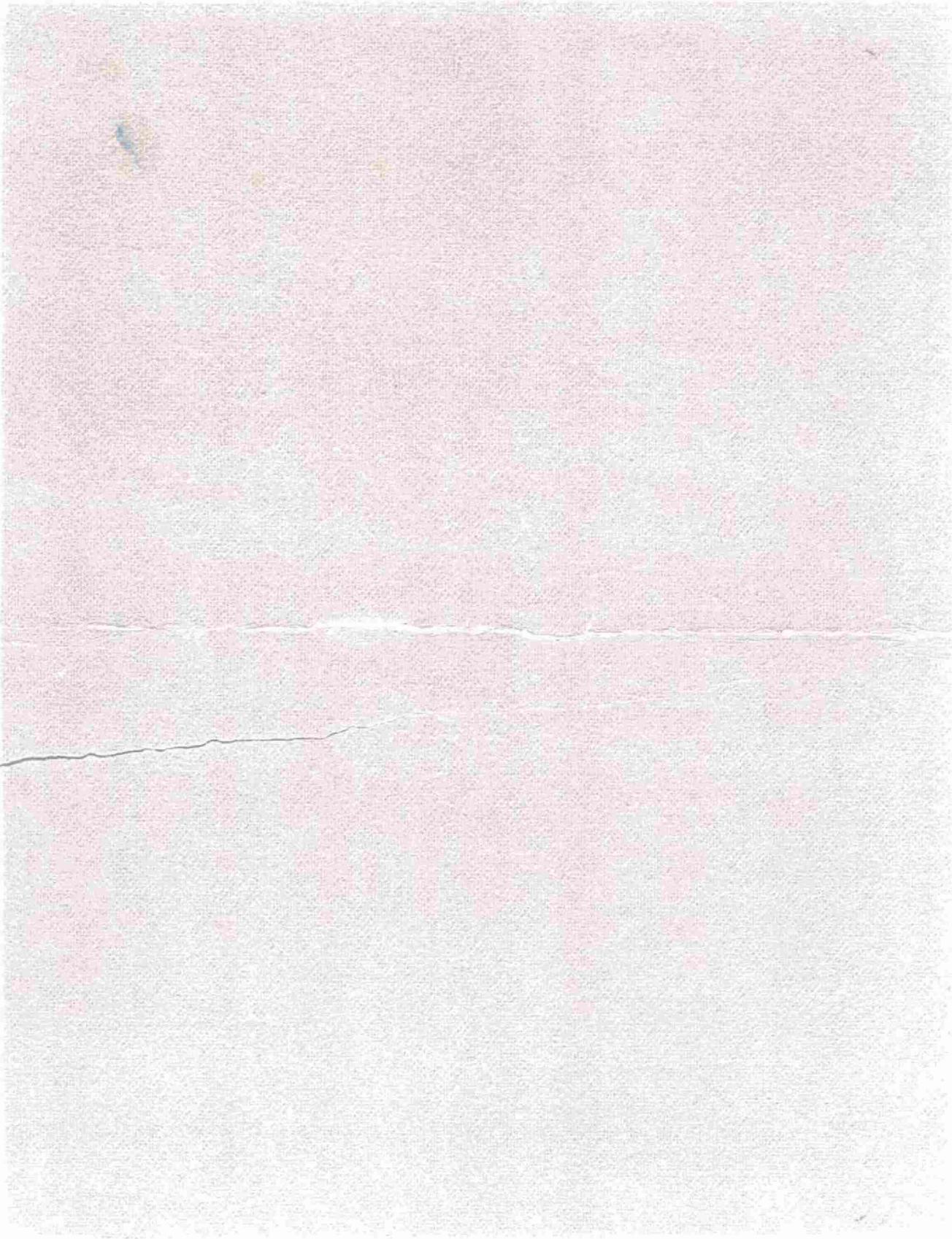


Plate 12. Valid Sample - Possible Loss of Mass
Torn filter - margins.
The filter margins (bottom and right side) have been torn straight as if cut by a scalpel.
LIMS code TF (torn filter).

Plate 12

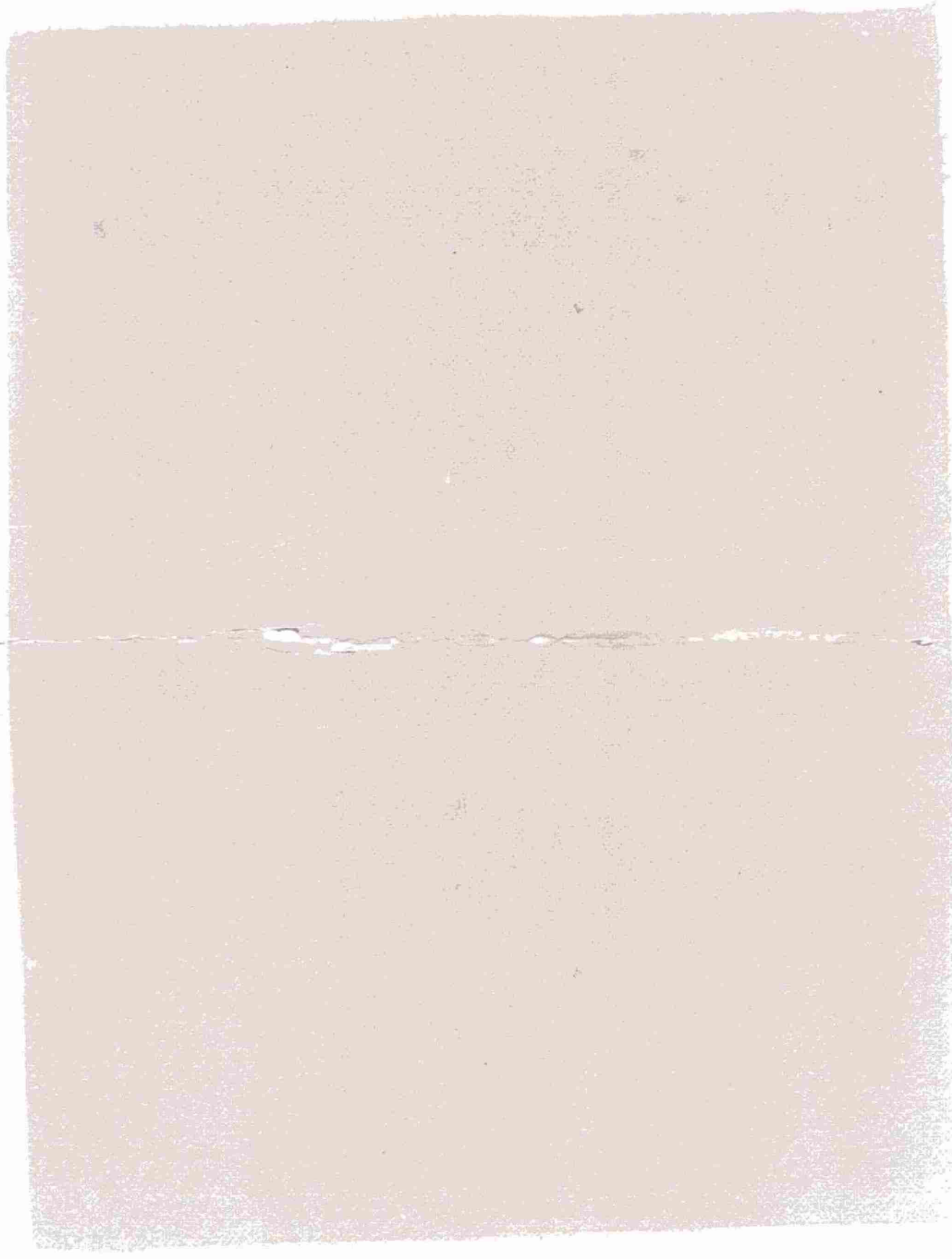


Plate 13. Valid Sample - Possible Loss of Mass
Torn filter - scrape.
This filter was torn after sampling. Note that the torn edge is white indicating particulate loss.
LIMS codes TF (torn filter), PPL (possible particulate loss).

Plate 13

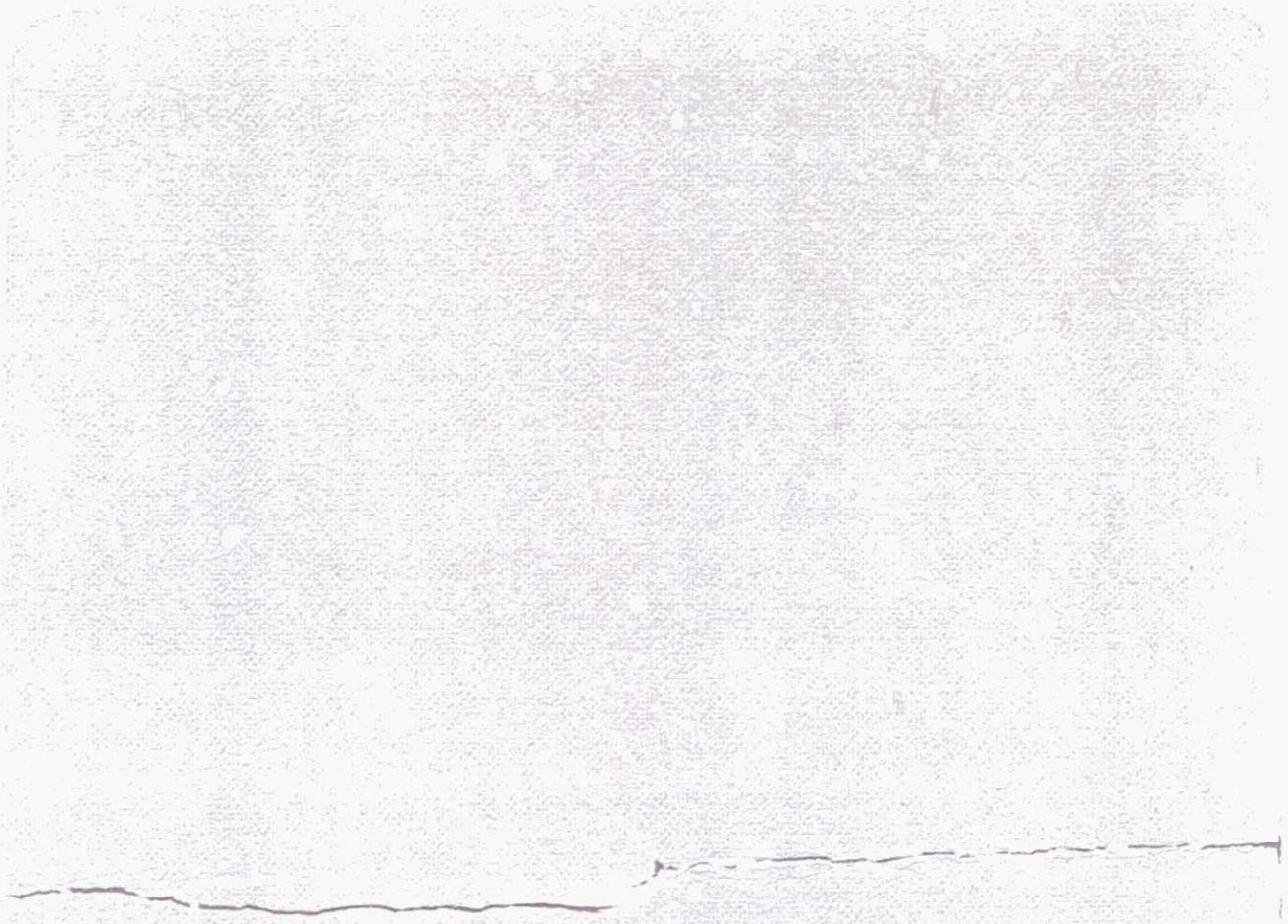


Plate 14. Valid Sample - Possible Loss of Mass
Improper exposure in sampler.
A crease/wrinkle in the filter allowed air flow to leak under the gasket.
LIMS codes PIE (possible improper exposure), PPL (possible particulate loss).

Plate 14

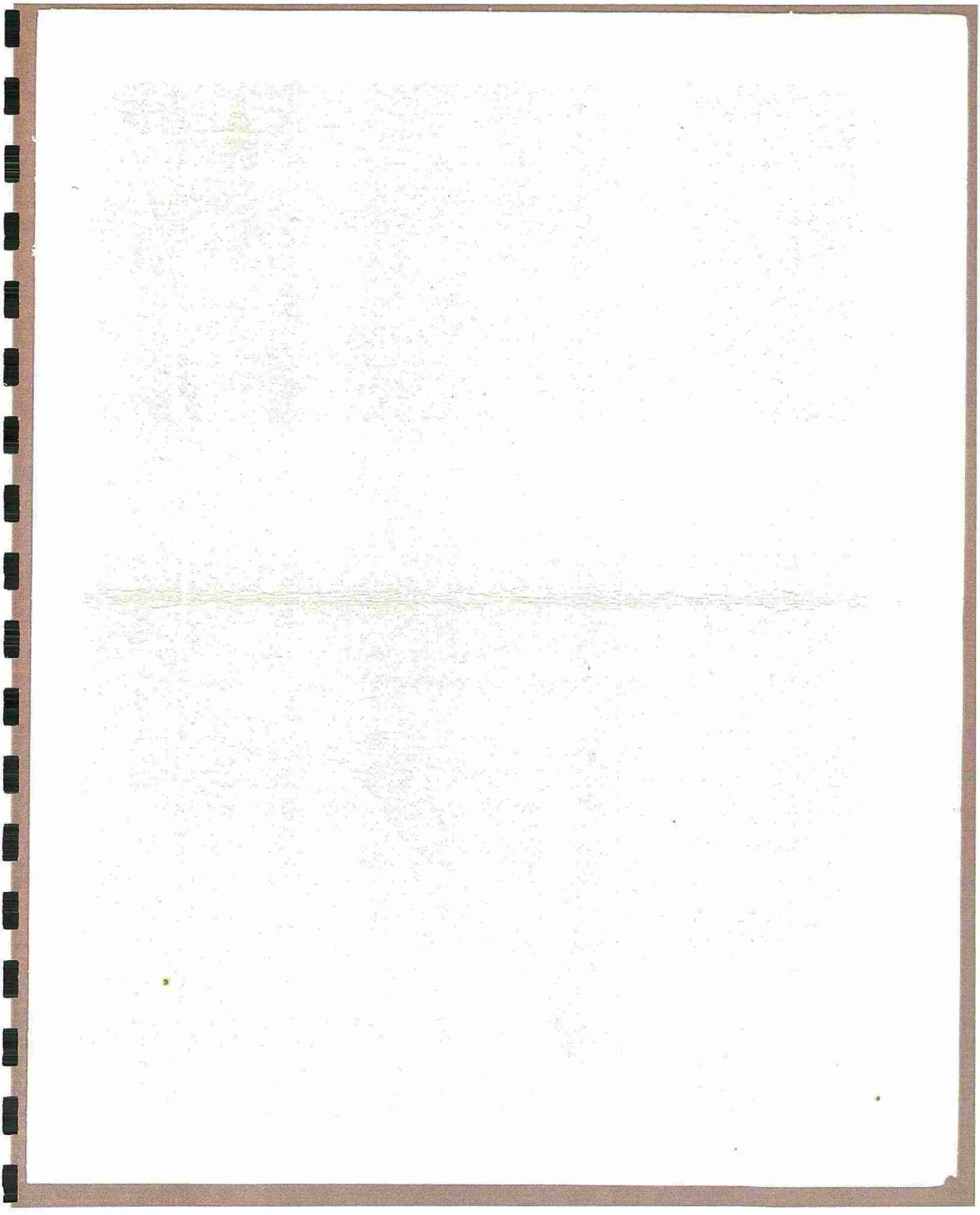


Plate 15. Valid Sample - Possible Loss of Mass
Improper exposure.
An object such as a leaf stem or a wire lying across the margin of the filter, or a crack through the gasket could cause a leak.
LIMS codes PIE (possible improper exposure), PPL (possible particulate loss).

Plate 15

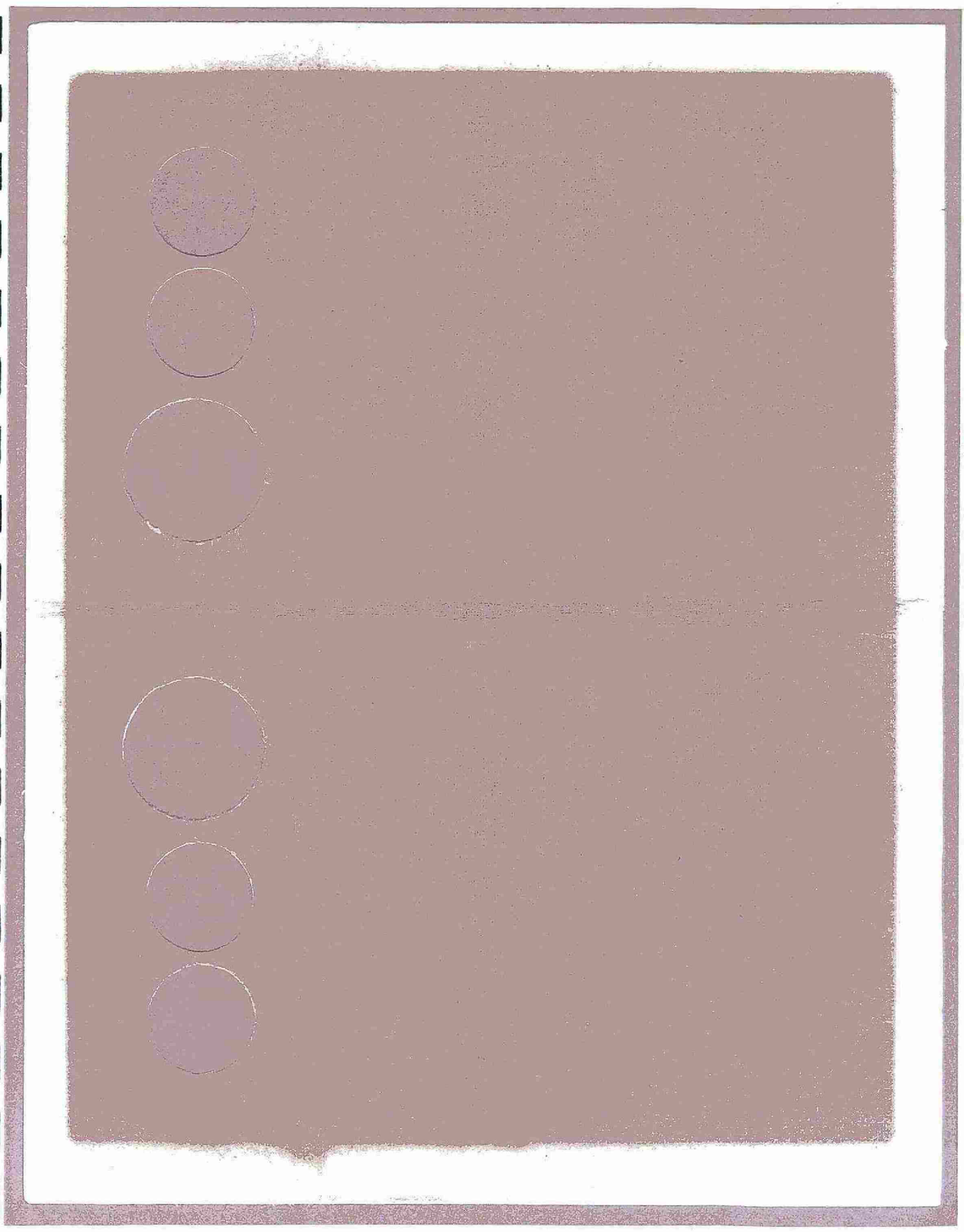


Plate 16. Valid Sample - Possible Loss of Mass
Improper exposure.
An improper gasket seal.
LIMS codes PIE (possible improper exposure), PPL (possible particulate loss).

Plate 16

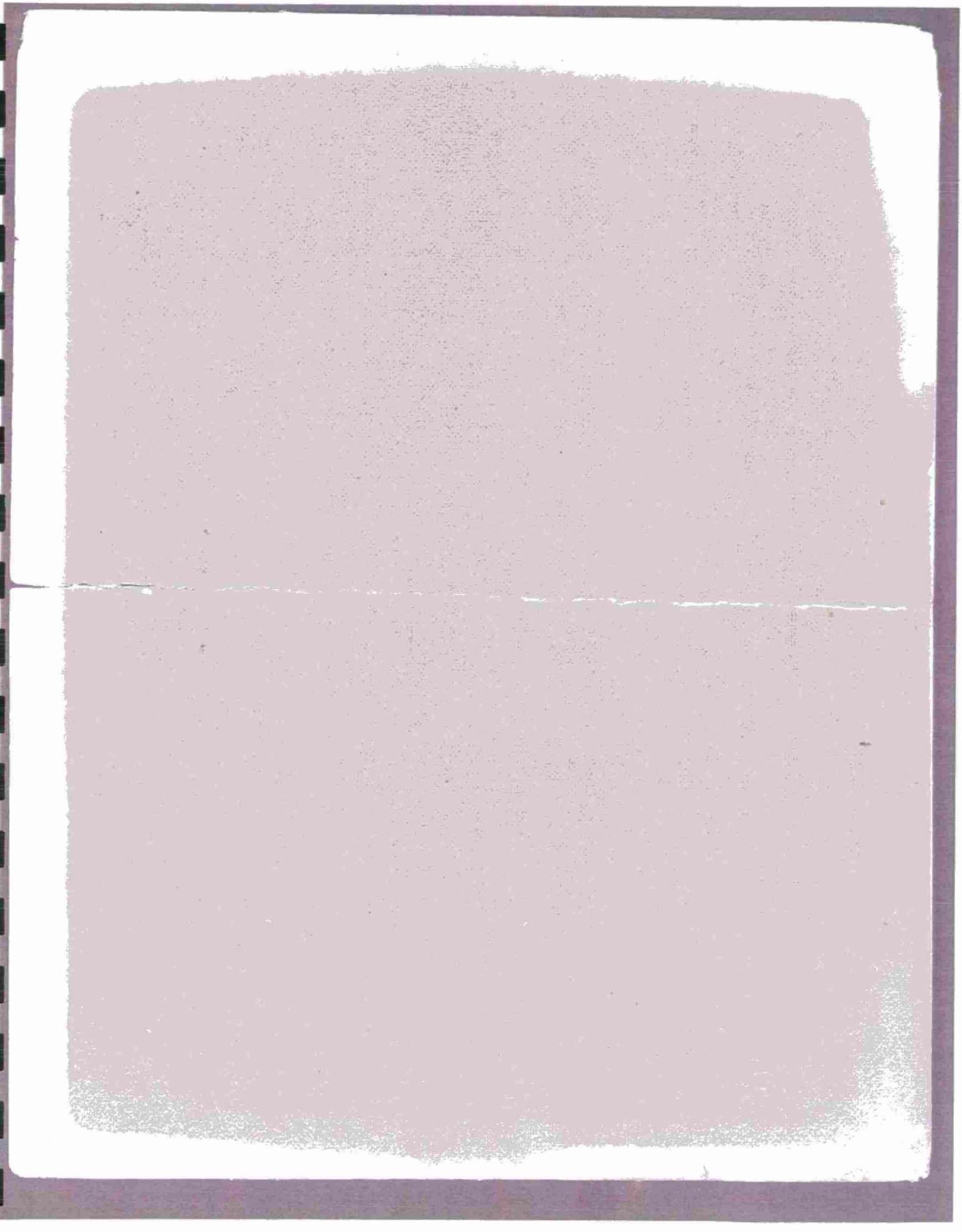


Plate 17. Valid Sample - Possible Loss of Mass (in the sense of the particulate having been not collected in the first place)
Improper exposure.
The sample is too white. It appears unexposed. The particulate may or may not have come from a dirty gasket.

Plate 17

Plate 18. Valid Sample - Possible Gain of Mass
Bird dropping.
LIMS code PFC (possible filter contamination).

Plate 18

Plate 19. Valid Sample - Possible Gain of Mass
Bird dropping residue.
The same dropping as in Plate 18, as seen on the unexposed surface of the filter.

Plate 19

Plate 20. Valid Sample - Possible Gain of Mass
Catkin fluff (edge-on view) (remove if possible).
LIMS code PFC (possible filter contamination).

Plate 20

Plate 21. Valid Sample - Possible Gain of Mass
Plant seed in bottom right corner (remove if possible).
LIMS code PFC (possible filter contamination).

Plate 21

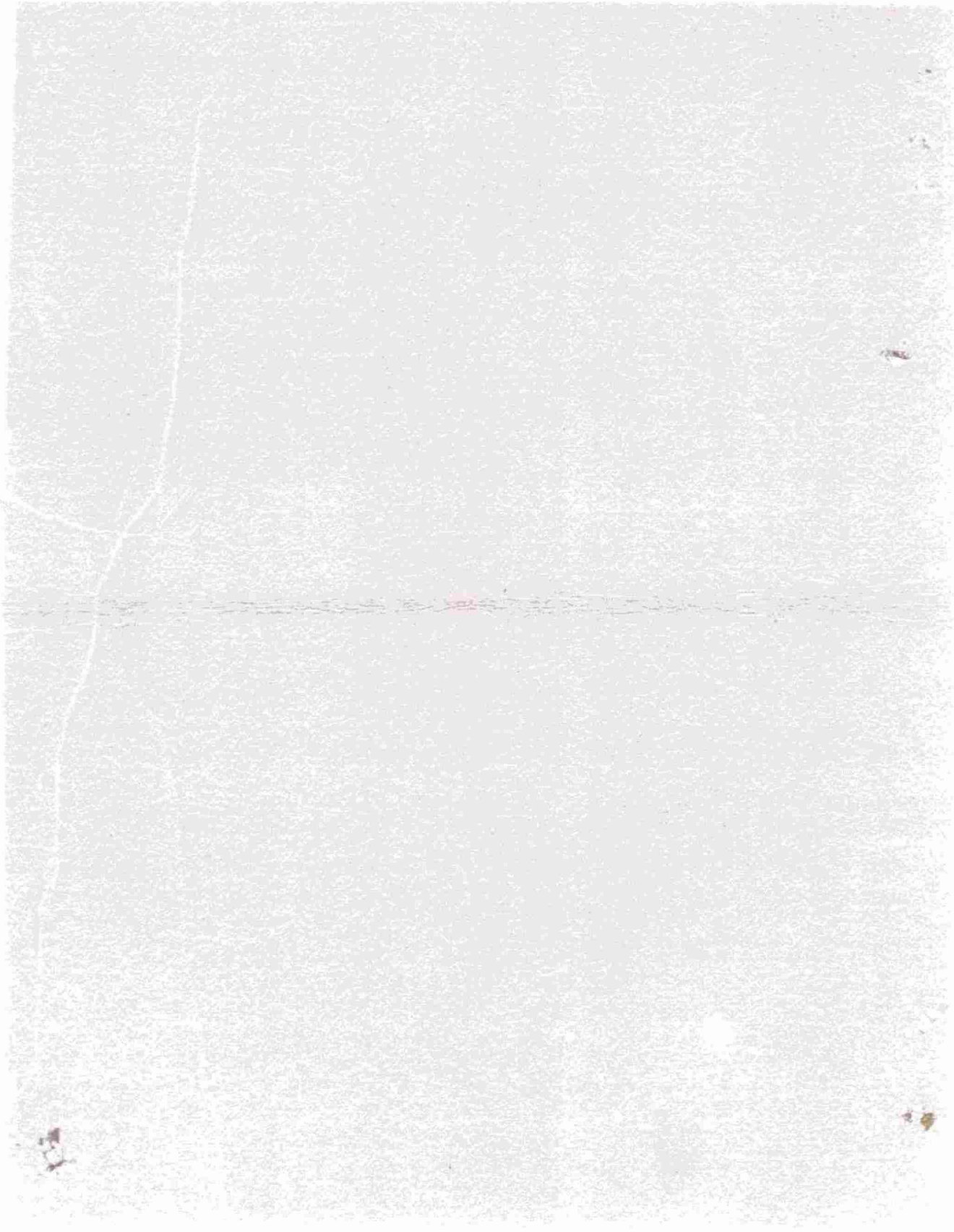


Plate 22 . Valid Sample - Possible Gain of Mass
Moth (remove if possible).
LIMS code PFC (possible filter contamination).

Plate 22

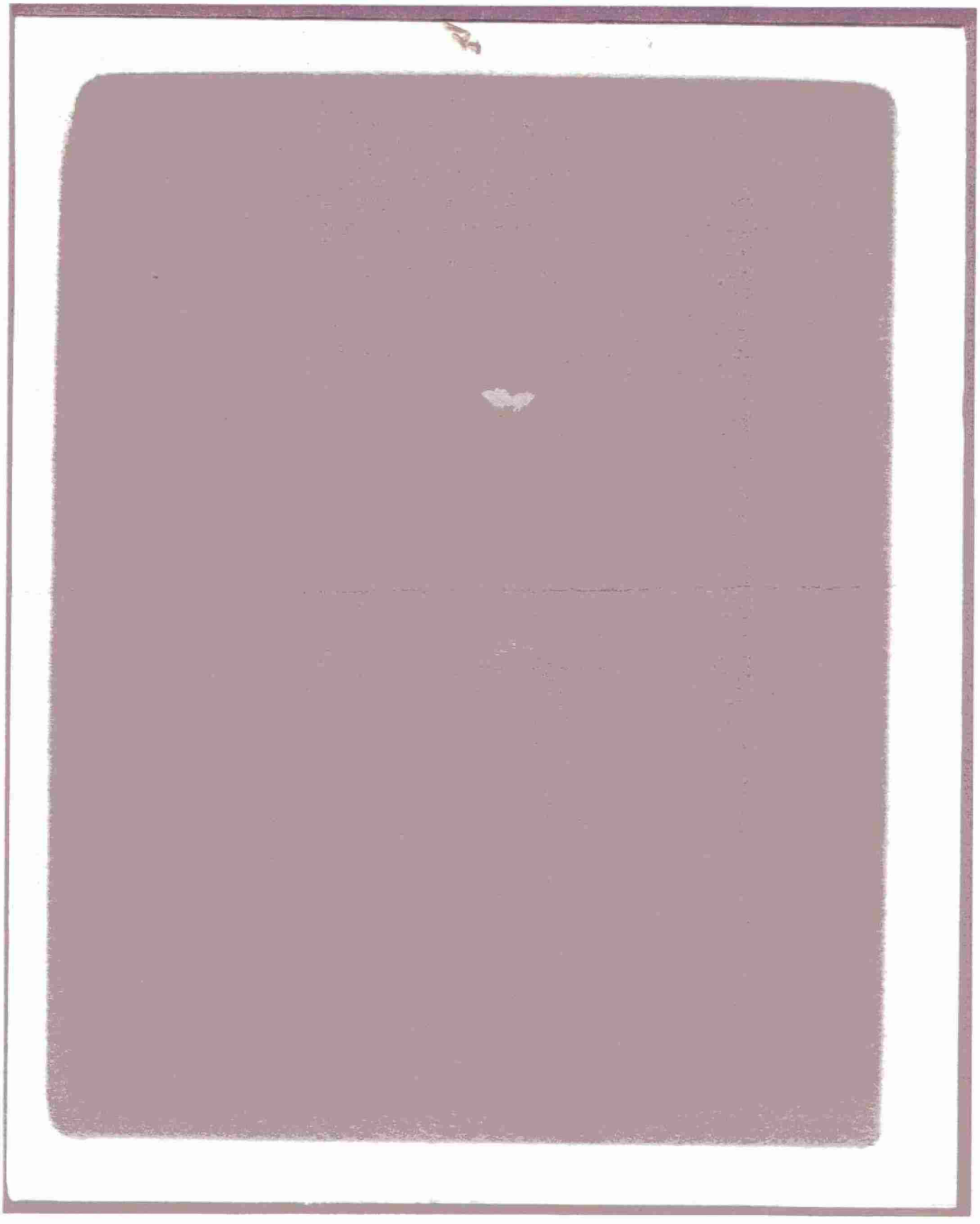


Plate 23. Valid Sample - Possible Gain of Mass
Dark, 'oily' spots and pale spots may be insect or spider droppings.
LIMS code PFC (possible filter contamination).

Plate 23

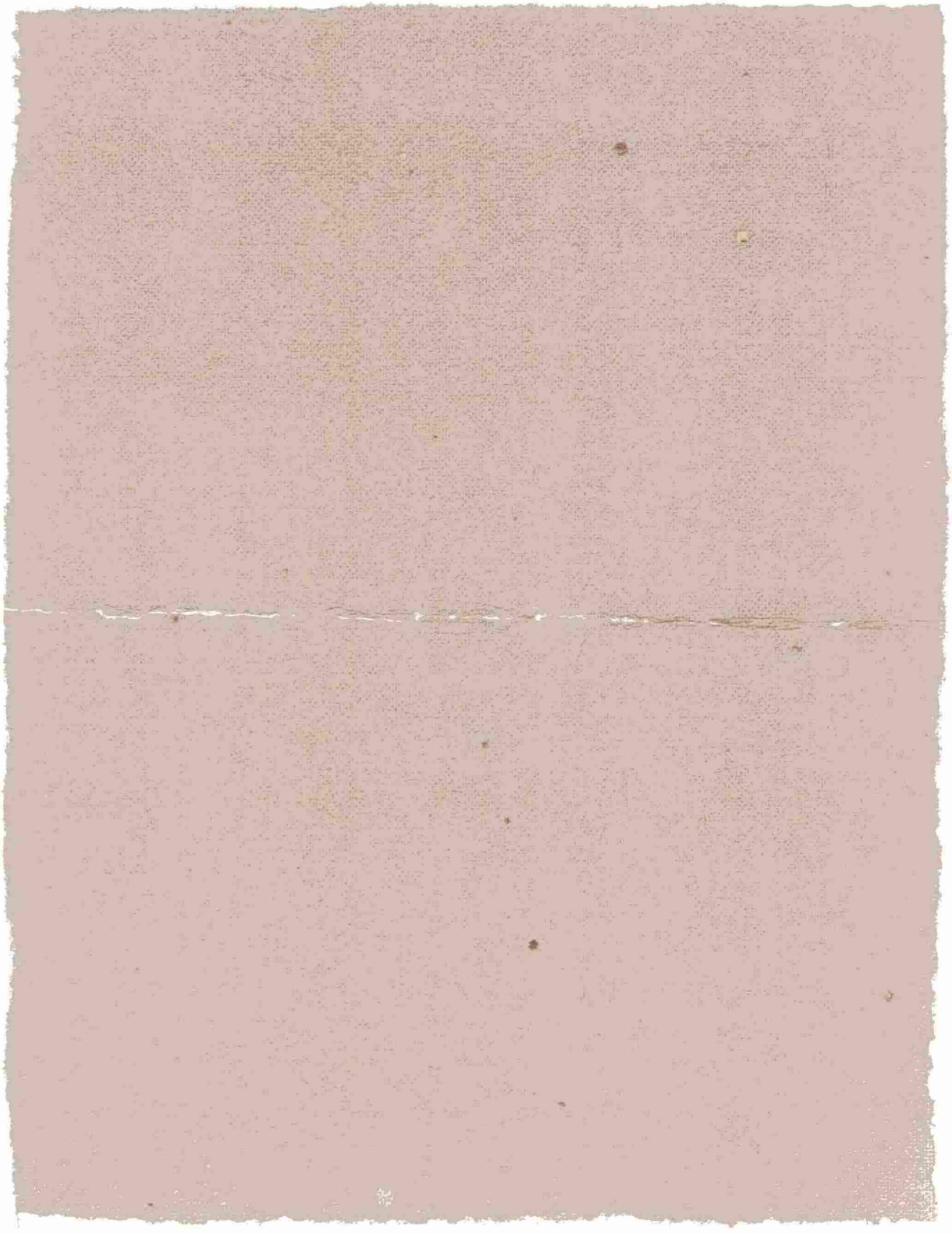
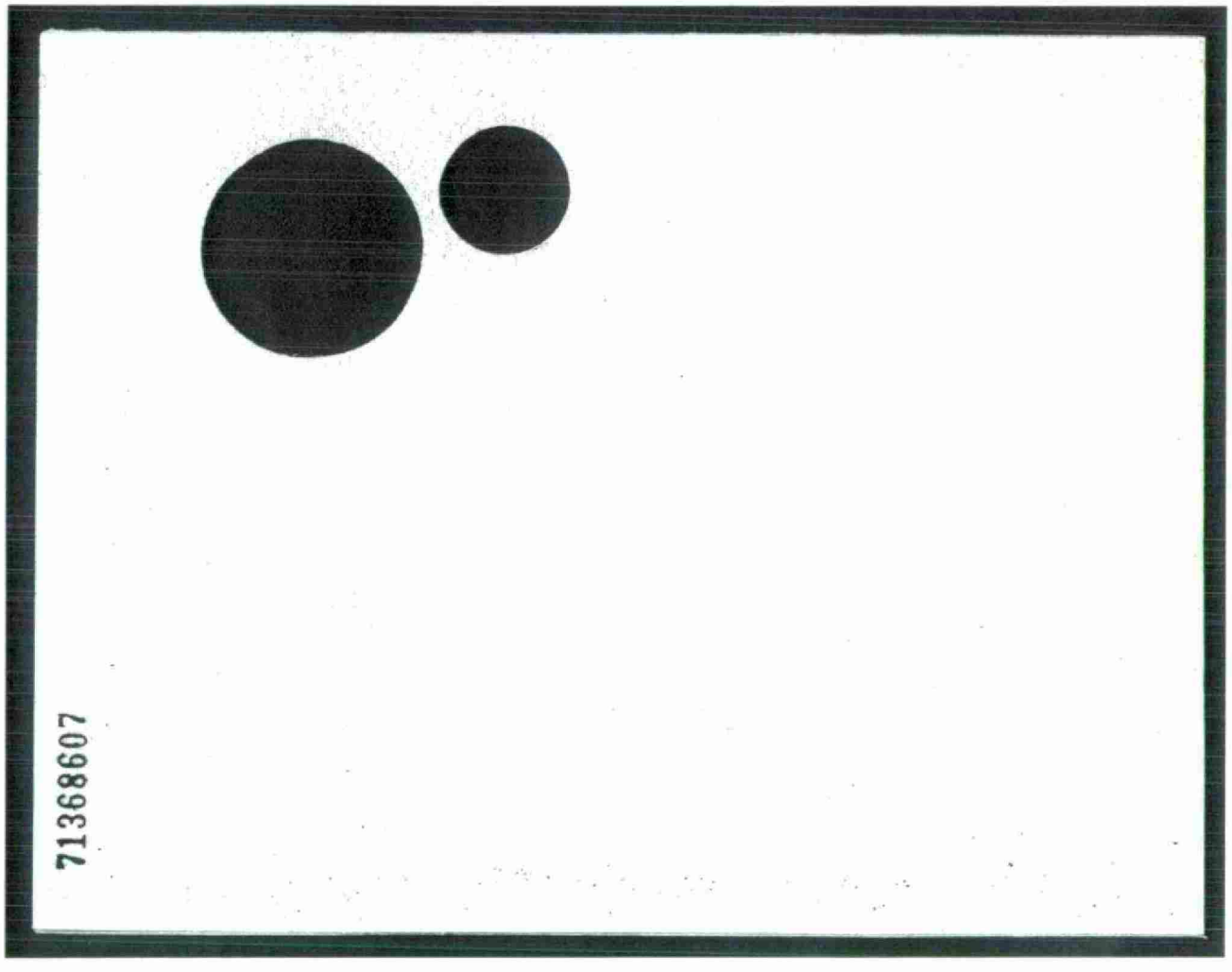


Plate 24. Valid Sample - Possible Gain of Mass
Dirty filter holder
Contamination of the unexposed margin from a dirty filter holder
LIMS code PCF (possible filter contamination).

Plate 24



71368607

Plate 25. Valid Sample - Possible Gain of Mass
Possible contamination of the exposed surface from a dirty gasket.
LIMS code PFC (possible filter contamination).

Plate 25

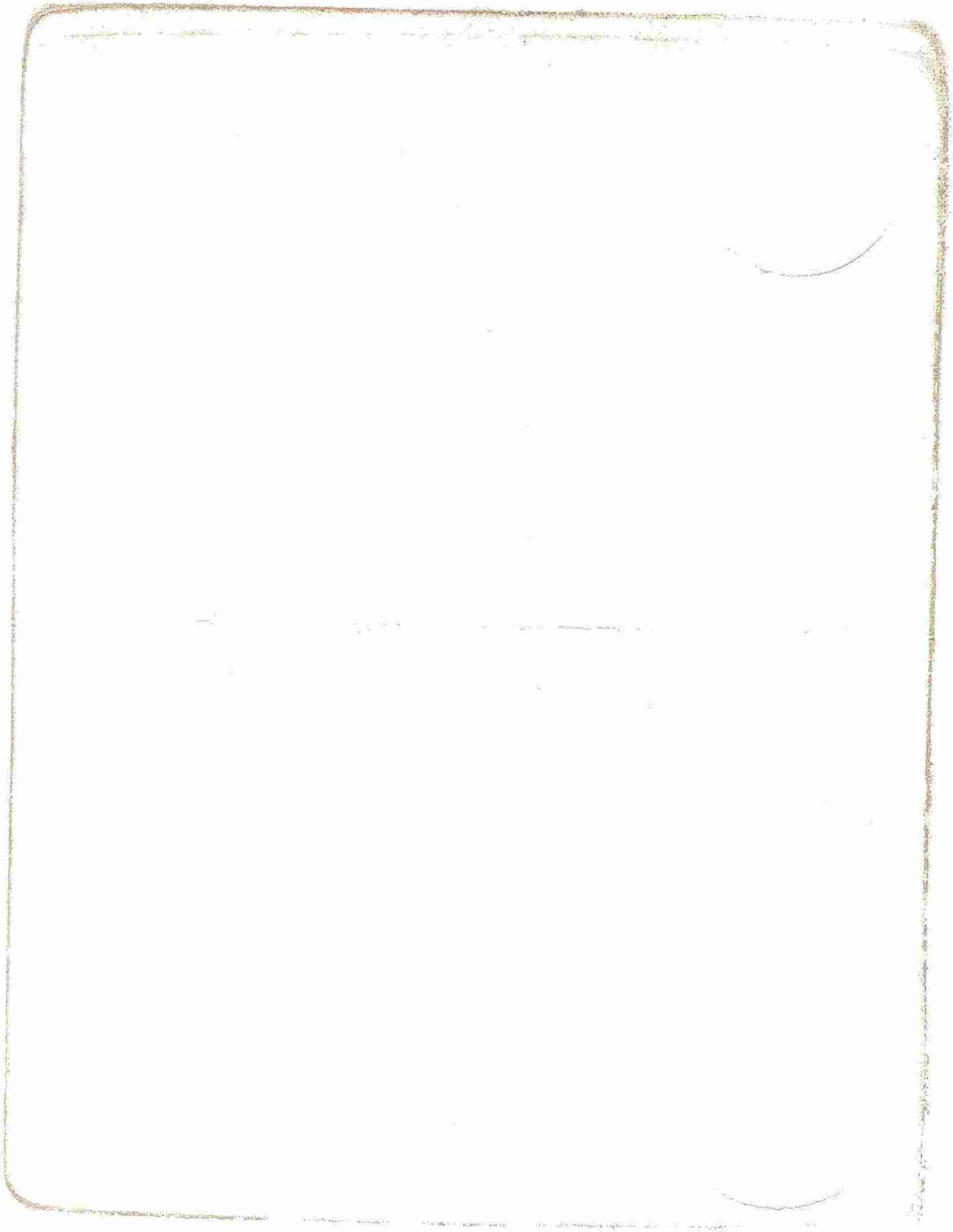


Plate 26. Valid Sample - Possible Loss and Gain of Mass
Bird dropping - LIMS code PFC (possible filter contamination).
Bird scratch marks - LIMS code PPL (possible particulate loss).

Plate 26

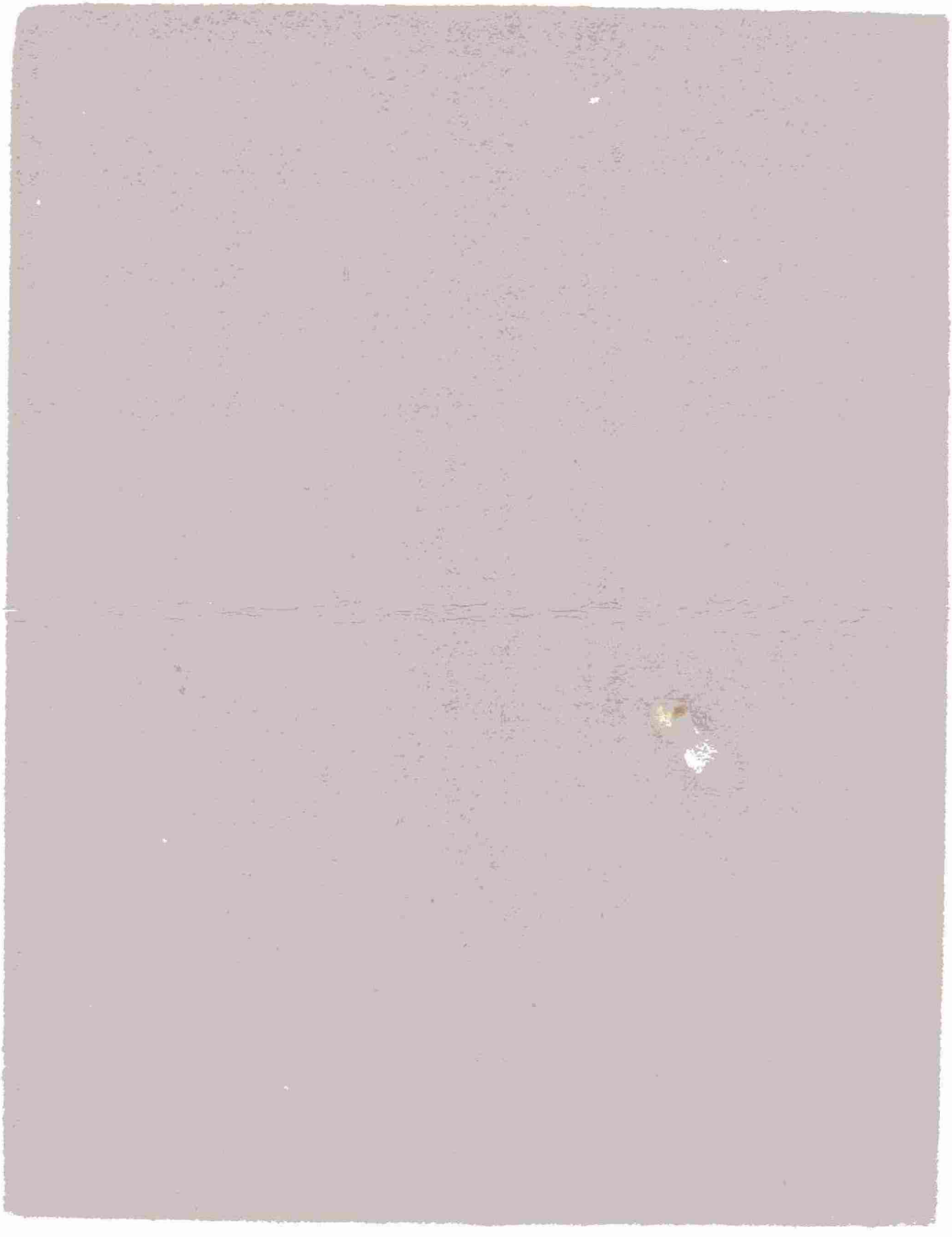
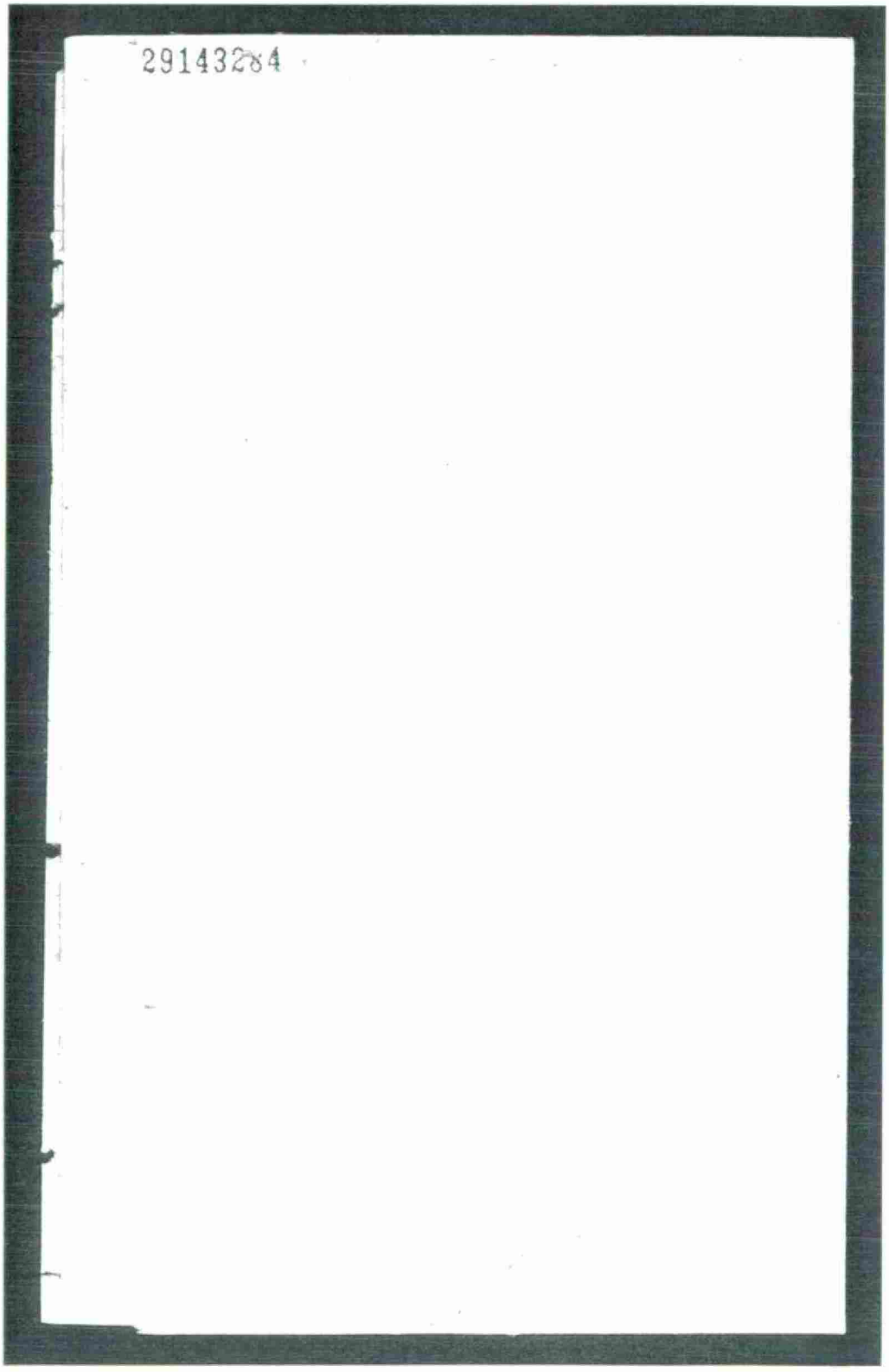


Plate 27. Valid Sample - Possible Loss and Gain of Mass
Dark, 'oily' brown spots may be insect or spider droppings. LIMS code PFC (possible filter contamination).
LIMS codes TF (torn filter), PPL (possible particulate loss).

Plate 27

Plate 28. Valid Sample - Possible Loss and Gain of Mass
Exterior view - The margin of the filter was covered with sand. It was embedded in the exterior (unexposed) surface. This was obvious contamination; there was nothing this large in the exposed area of the filter. LIMS code PFC (possible filter contamination) Removing the sand left holes in the filter. LIMS codes TF (torn filter).

Plate 28



APPENDIX B

Sample Envelopes

Figure 1
An invalid Hi-vol sample.

Figure 2
A valid PM10 sample.

STATION 17014

HI-VOL No. ..... DATE 16-NOV-2000

FILTER No. 674 TYPE H.G. BATCH No. 7579

OPERATOR ..... ON ..... OFF .....

FLOW READING ..... ON ..... OFF .....

COMMENTS INVALID

Flow controller malfunction

TOTAL VOLUME — CU. M.

WEIGHT ..... ON ..... OFF .....

WEIGHT DIFFERENCE .....

0887 (01/90)

FIGURE 1

STATION 12559

HI-VOL No. ..... DATE 14-OCT-2000

FILTER No. 1258344 TYPE Q4 BATCH No. 002283

OPERATOR ..... ON ..... OFF .....

FLOW READING ..... ON ..... OFF .....

COMMENTS Large brown stain in corner

.....

.....

TOTAL VOLUME 1631 ..... CU. M.

WEIGHT ..... ON ..... OFF .....

WEIGHT DIFFERENCE .....

0887 (01.90)

FIGURE 2

APPENDIX C

SUBMISSION FORMS

INVALID SAMPLES

TSPINV3288 is the LIMS product code to use for all invalid samples.

1. If a date is on the form for which a sample was not intended to be taken, the entire line pertaining to that sample is crossed off so a LIMS sample number will not be generated. (See Figure 1.)

2. If a sample was to be taken but for any reason was not, (no access to site, motor failure, incorrect filter type, etc.), the air volume is changed to INVALID and the product is changed to TSPINV3288, so a LIMS sample number can be generated and the sample information entered into LIMS. All other sample number information (batch number, filter number) is entered on the sheets as usual. (See Figure 1.)

3. If the same filter is exposed for two consecutive sampling days, the air volume and product are invalid for both days. (See Figure 1.)

NON-ROUTINE SUBMISSIONS

1. If a sample or set of samples must be submitted before the end of the month the submission sheet is to be photocopied and all sample information that does NOT apply to the filters being submitted, is to be crossed off. Repeat this procedure as often as required. (See Figure 2.)

2. If a current submission sheet is not available, that of another station may be photocopied. All information not applicable to the filters being submitted, (station id, program code, product, etc.) is to be crossed out and the correct information written in and submitted to the appropriate laboratory. (Figure 3.)

FILTER SUBSTITUTION

1. If a filter is used at a station, other than that designated by the laboratory, the station ID, batch number and filter number **MUST** be entered in the appropriate columns on the submission form. (See Figure 4.)

2. If a filter is used at a station other than that designated by the laboratory, the eight-digit station-filter ID number must be entered in the Filter Number column. The correct batch number must be entered in its column.

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MINISTRY OF ENVIRONMENT LABORATORY SERVICES BRANCH

MOE*LIMS Sample Submission Form

Submission Number	Client ID 21110	Program Code 130113102	Priority NN	Page 1
Prelog Number	Sample Location / Municipality HAMILTON		Date Submitted (DD-MMM-YYYY)	

Client Contact	Ministry / Branch / Office	Telephone Number	Fax Number
FRANK DOBROFF	WEST CENTRAL HAMILTON P.O. BOX 2112 119 KING ST W., 12TH F	905-521-7706	905-521-7820
		City / Town: HAMILTON	Postal Code: L8P 4Y7

Sampled By	Telephone Number	Sample Reception / Data Entry
BILL SPARKS	905-573-3693	

Station ID 29118 | Matrix AG

Lab Sample Numbers: Sample Number	Lab Sample Numbers: MOE*LIMS	Sample Date (DD-MMM-YYYY)	Filter Number	Batch Number	Air Volume	Product	Remarks
Sample Number	MOE*LIMS	1-Mar-1999			1631	HVA	Check Filter Yes --
Sample Number	MOE*LIMS	7-Mar-1999	1	4848	1631	HVA	Check Filter Yes -- NEW STATION
Sample Number	MOE*LIMS	13-Mar-1999	2	"	1631	HVA	Check Filter Yes --
Sample Number	MOE*LIMS	19-Mar-1999	3	"	~~1631~~ INVALID	~~HVA~~ TSPINV3288	Check Filter Yes -- RAN TWICE
Sample Number	MOE*LIMS	25-Mar-1999	3	"	~~1631~~ INVALID	~~HVA~~ TSPINV3288	Check Filter Yes -- RAN TWICE
Sample Number	MOE*LIMS	31-Mar-1999	4	"	1631	HVA	Check Filter Yes --

Additional Comments

Figure 1

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MINISTRY OF ENVIRONMENT LABORATORY SERVICES BRANCH

Particulate Air Program

Submission Number	Client ID 19189	Program Code 130114102	Priority NN	Page 1
Prelog Number	Sample Location / Municipality SOUTHWESTERN REGION		Date Submitted (DD-MMM-YYYY)	

Client Contact	Ministry / Branch / Office	Telephone Number	Fax Number
DAN DOBRIN	MINISTRY OF ENVIRONMENT 2nd Floor 661 Exeter Road, South	519-873-5000	519-873-5020
		City / Town: LONDON	Postal Code: N6E 1L3

Sampled By		Telephone Number	Sample Reception / Data Entry
SCOTT KENNEDY	MIKE PARKER	519-873-5046	

Station ID 12507 | Matrix AQ

Lab Sample Numbers		Sample Date (DD-MMM-YYYY)	Filter Number	Batch Number	Air Volume	Product	Remarks
Sample Number	MOE*LIMS	1-Mar-1999	853	7579	1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	7-Mar-1999	554	7579	1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	13-Mar-1999			1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	19-Mar-1999			1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	25-Mar-1999			1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	31-Mar-1999			1631	QUARTZ	Check Filter Yes

Additional Comments 7-MAR-1999 - PRIORITY POLLUTION INCIDENT
14-MAR-1999 - SAMPLE DRE[illegible]

Figure 2

Shaded Area Lab Use Only

MINISTRY OF ENVIRONMENT LABORATORY SERVICES BRANCH

MOE*LIMS Sample Submission Form

Submission Number	Client ID 19189	Program Code 13011410~~7~~ 3	Priority NN	Page 1
Prelog Number	Sample Location ~~ST. MARYS~~ / Municipality TECUMSEH		Date Submitted (DD-MMM-YYYY)	

Client Contact	Ministry / Branch / Office	Telephone Number	Fax Number
DAN DOBRIN	MINISTRY OF ENVIRONMENT 659 EXETER ROAD 2nd Floor	519-873-5000	519-661-1742
		City / Town: LONDON	Postal Code: N6E 1L3

Sampled By		Telephone Number	Sample Reception / Data Entry
MIKE PARKER	SCOTT KENNEDY	519-873-504	

Station ID 11001~~-~~ 12583 Matrix ~~AG~~ AQ

Lab Sample Numbers		Sample Date (DD-MMM-YYYY)	Filter Number	Batch Number	Air Volume	Product	Remarks
Sample Number	MOE*LIMS	~~5-Jul-~~1999 1-MAR	253	74608	1631	~~HVA~~ QUARTZ	Check Filter Yes –
Sample Number	MOE*LIMS	~~11-Jul-~~1999 7-MAR	254	"	1631	~~HVA~~	Check Filter Yes –
Sample Number	MOE*LIMS	~~17-Jul-~~1999 13-MAR	255	"	1631	~~HVA~~	Check Filter Yes –
Sample Number	MOE*LIMS	~~23-Jul-~~1999 19-MAR	256	"	1631	~~HVA~~	Check Filter Yes –
Sample Number	MOE*LIMS	~~29-Jul-~~1999 25-MAR	257	"	1631	~~HVA~~	Check Filter Yes –
Sample Number	MOE*LIMS	~~N/A~~ 31-MAR	258	"	~~N/A~~ 1631	~~N/A~~	Check Filter Yes –

Additional Comments

Figure 3

Type or Print Clearly
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MINISTRY OF ENVIRONMENT LABORATORY SERVICES BRANCH

Particulate Air Program

Submission Number	Client ID 54528	Program Code 130115302	Priority NN	Page 1
Prelog Number	Sample Location / Municipality: COPPER CLIFF WALDEN		Date Submitted (DD-MMM-YYYY)	

Client Contact	Ministry / Branch / Office	Telephone Number	Fax Number
DON RACETTE	MOE / NORTHERN REGION 435 JAMES STREET SOUTH	807-475-1216	807-475-1754
		City / Town: THUNDER BAY	Postal Code: P7E 6S7

Sampled By	Telephone Number	Sample Reception / Data Entry
WILFRED TREMBLAY	705-564-3201	

Station ID 77570 | Matrix AQ

Lab Sample Numbers		Sample Date (DD-MMM-YYYY)	Filter Number	Batch Number	Air Volume	Product	Remarks
Sample Number	MOE*LIMS	2-Dec-1999	324	711862	1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	8-Dec-1999	325	711862	1631	QUARTZ	Check Filter Yes ✓
Sample Number	MOE*LIMS	14-Dec-1999	326	711280	1631	QUARTZ -IP3288	Check Filter Yes -- Filter tore Piece missing
Sample Number	MOE*LIMS	20-Dec-1999	71368012	711862	1631	QUARTZ	Check Filter Yes -- USED FILTER FROM STATION 71368
Sample Number	MOE*LIMS	26-Dec-1999	327	711280	1631	QUARTZ	Check Filter Yes --
Sample Number	MOE*LIMS	N/A			0	N/A	Check Filter Yes --

Additional Comments

Figure 4

APPENDIX D

TABLE D-1
LIMS PARENT PRODUCTS / PRODUCTS FOR HI-VOL FILTERS
See glossary (page 13) for additional, explanatory remarks

* PARENT PRODUCT	Matrix	PRODUCT	DESCRIPTION	LIMS PRODUCT DESCRIPTION
HVA	AG	TSP2009 / TSP3288	TSP only	Particulate Loading
HVB	AG	TSP2009 PB3233	TSP Lead	Particulate Loading + Lead in Air Particulate
HVC	AG	TSP2009 HIVOL3070	TSP Metals	Particulate Loading + Metals in Air Particulate by XRF
HVD	AG	TSP2009 ANION3004 HIVOL3070	TSP Anions Metals	Particulate Loading + Anions in Air Particulate Glass Fibre + Metals in Air Particulate by XRF
HVE	AG	TSP2009 ANION3004 PB3233	TSP Anions Lead	Particulate Loading + Anions in Air Particulate Glass Fibre + Lead in Air Particulate
HVF	AG	TSP2009 ANION3004 PB3233 CARB3361	TSP Anions Lead Total & Free Carbons	Particulate Loading + Anions in Air Particulate Glass Fibre + Lead in Air Particulate +Total & Free Carbon in Air Particulate
HVG	AG	TSP2009 CARB3361 HIVOL3070	TSP Total & Free Carbons Metals	Particulate Loading + Total & Free Carbon in Air Particulate + Metals in Air Particulate by XRF
HVH	AG	TSP2009 CARB3361	TSP Total & Free Carbons	Particulate Loading + Total & Free Carbon in Air Particulate
HVM	AG	TSP2009 ID3092	TSP Ident.	Particulate Loading + Particulate Microscopy for Complaints
HVN	AG	TSP2009 ANION3004 RAD3167	TSP Anions Gross Beta	Particulate Loading + Anions in Air Particulate Glass Fibre + Gross Beta in Air Particulate - RPL
HVO	AG	TSP2009 ANION3004 PB3233 RAD3167	TSP Anions Lead Gross Beta	Particulate Loading + Anions in Air Particulate Glass Fibre + Lead in Air Particulate + Gross Beta in Air Particulate - RPL
HVQ	AG	TSP2009 RAD3167	TSP Gross Beta	Particulate Loading + Gross Beta in Air Particulate - RPL

TABLE D-1
LIMS PARENT PRODUCTS / PRODUCTS FOR HI-VOL FILTERS

See glossary (page 13) for additional, explanatory remarks

* PARENT PRODUCT	Matrix	PRODUCT	DESCRIPTION	LIMS PRODUCT DESCRIPTION
HVS	AG	TSP2009 HIVOL3070 RAD3167	TSP Metals Gross Beta	Particulate Loading + Metals in Air Particulate by XRF + Gross Beta in Air Particulate - RPL
HVT	AG	TSP2009 ANION3004 CARB3361 HIVOL3070	TSP Anions Total & Free Carbons Metals	Particulate Loading + Anions in Air Particulate Glass Fibre +Total & Free Carbon in Air Particulate +Metals in Air Particulate by XRF
HVV	AG	TSP2009 ANION3004 HIVOL3070 RAD3167	TSP Anions Metals Gross Beta	Particulate Loading + Anions in Air Particulate Glass Fibre + Metals in Air Particulate by XRF + Gross Beta in Air Particulate -RPL
HVW	AG	TSP2009 ANION3004	TSP Anions	Particulate Loading + Anions in Air Particulate Glass Fibre
HVY	AG	TSP3288 HIVOL3070 ZN3070	TSP ***(LSB)*** Metals **Zinc**	Particulate Loading + Metals in Air Particulate by XRF +Zinc in Hi-vol Filters

* Commonly used Parent Products. Other Parent Products are available.

TABLE D-2

LIMS PARENT PRODUCT / PRODUCTS FOR PM-10 FILTERS

See glossary (page 13) for additional, explanatory remarks.

PARENT PRODUCT	Matrix	PRODUCT	DESCRIPTION	LIMS PRODUCT DESCRIPTION
QUARTZ	AQ	IP3288 ANION3004 CD3402 XRF3277	PM10 SO_4 Cadmium XRF Metals	Particulate Loading - PM10 Filters + Anions in Air Particulate Glass Fibre + Cadmium in Air Filters + EDXRF Metals in Air Particulate -Quartz

TABLE D-3

LIMS PRODUCT FOR ALL INVALID AIR FILTERS

See glossary (page 14) for additional, explanatory remarks.

PRODUCT	Matrix	DESCRIPTION	LIMS PRODUCT DESCRIPTION
TSPINV3288	AG / AQ	TSP / PM10 Invalid	Particulate Loading (TSP Invalid)